CLINICAL THERAPEUTICS

I. THERAPEUTIC AGENTS
II. THERAPEUTIC PROCEDURES
III. THE TREATMENT OF SYMPTOMS
IV. THE TREATMENT OF DISEASES

BY

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SECOND EDITION

AUTHORIZED ENGLISH TRANSLATION FROM THE THIRD REVISED AND ENLARGED FRENCH EDITION

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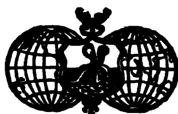
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WITH 370 TEXT ENGRAVINGS

COMPLETE IN TWO ROYAL OCTAVO VOLUMES

VOLUME I

THERAPEUTIC AGENTS AND PROCEDURES



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PREFACE TO THIRD FRENCH EDITION

Since the preceding edition of this work, certain drugs, such as quinidine, ouabain, etc., have come increasingly into vogue in medical practice; amplification of the text concerned with their indications and modes of application has therefore been necessary. Among other drugs added in the present edition are various new arsenical compounds, benzyl benzoate, papaverine, oil of chenopodium, carbon tetrachloride, etc.

Among medical therapeutic procedures, increased space has been devoted to kinesitherapy, in particular as regards the reëducation of certain muscles, respiratory exercises, the treatment of phlebitis in the lower extremities, artificial respiration, etc. Blood transfusion and artificial pneumothorax, two procedures to which much attention is now being paid, have been brought up to date through the description of recently advised methods of procedure. Cryotherapy, or the application of cold, has assumed a definite place in daily practice.

The increasing use of immunizing bouillon-vaccines in external dressings, according to Besredka's method, has made needful the preparation of a section on local immunity. The vaccines and serums are steadily increasing in number; thus, we now have the vaccine for cerebrospinal meningitis, that against diphtheria, convalescent blood or serum for measles, scarlet fever, and whooping cough.

The portion of the work on symptomatic therapeutics has been extended by the addition of sections on the treatment of headache, migraine, and vertigo. To the infectious diseases, epidemic encephalitis has been added.

The section on treatment of disorders of the digestive tract has been recast. In the treatment of the respiratory tract, attention has been paid to the use of oxygen in massive doses, and to that of vaccines, antipneumococcic serum, antigangrenous serum, etc. The disposal of tuberculous patients in suitable institutions has been given some consideration. Certain newer methods in the treatment of skin diseases have been added, *viz.*, hemotherapy and cryotherapy. The treatment of syphilis with bismuth has assumed such importance of late that a special discussion of it has become necessary. The treatment of epilepsy is no longer limited to the prescription of bromides,

with all their disadvantages: Phenobarbital, borico-potassic tartrate, and arsenic now constitute fortunate substitutive measures.

Lastly, mention should be made, among the chapters which have had to be added, on account of their novelty, that on the treatment of diabetes mellitus by insulin, which represents one of the most important therapeutic conquests of late years.

X-ray therapy, that of cancer in particular, has seen wider use, and radium therapy, on account of its increasingly important rôle in therapeutics, has called for the preparation of a more extensive chapter. In this connection a new contributor has been added in the person of Madame Laborde, well known for her investigations on radium, who kindly consented to enrich this work with the gleanings of her experience.

The general plan of the work as a whole has already been outlined in earlier prefaces.

PREFACE

This work is the logical and necessary complement to an earlier work entitled "Clinical Diagnosis," of which five French and three American editions have already appeared. It was conceived in the same spirit of "pragmatic" serviceability, and this objective has been kept in mind even to the extent of preserving a typographical similarity of the two works. Indeed, the latter constitute, properly speaking, but a single treatise: A manual of practical medicine based on an essentially novel plan, conforming to the actualities of practice and meeting clinical requirements.

Part I, entitled THERAPEUTIC AGENTS, is intended to bring before the reader the pharmaceutic (drug therapy), alimentary (dietetics), physical (physiotherapy) and mental (psychotherapy) agencies which are available to the therapeutist in combatting disease. Interspersed tables and synopses have made it possible to present the facts in a manner alike concise, clear and complete. Drs. Lomon and Mougeot have lent the author their especially valuable collaboration in the preparation of the sections on ELECTROTHERAPY, RÖNTGEN AND RADIUM TREATMENT, and CRENOTHERAPY.

Present-day therapeutics call for the application of TECHNICAL THERAPEUTIC PROCEDURES, becoming constantly more numerous, which are dealt with in Part II. With the collaboration of Dr. Desfosses I have described most of the procedures (intravenous injections, paracentesis thoracis, chest drainage, lumbar puncture, etc.)—from the lowliest (cupping, enemas, etc.), to the most taxing (puncture of the pericardium, neurolytic injections, etc.)—the application of which is now indispensable.

In Part III, entitled TREATMENT OF SYMPTOMS, the work bears an even closer relationship to "Clinical Diagnosis." The motive behind it is truly the same. Wherever possible, a tabular synopsis of the treatment of individual symptoms by physical and pharmaceutic meas-

ures has been inserted, affording a particularly comprehensive synthetic review.

Finally, Part IV deals with the TREATMENT OF DISEASES. With the valued collaboration of Drs. G. Laurens, Léon Meunier, Lutier, Martingay and Saint-Cène, I have sought to present in this section a clear, succinct and circumstantial account of clinical therapeutics in its present state. Let the reader not expect to find therein an all-embracing and impassive therapeutic catalog of all views, of whatever sort, held in ancient and modern times regarding the art of curing disease. The time for such exercises in compilatory prose composition is past. My co-workers and I have resolutely made our selections, trimmed off the dead branches and aged offshoots, and suppressed exuberant foliations, hoping thus, by concentrating the sap, to rejuvenate the parent stem and make the tree more vigorous.

ALFRED MARTINET.

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CLINICAL THERAPEUTICS.

INTRODUCTION TO THE STUDY OF CLINICAL THERAPEUTICS.

Sedare dolorem, divinum opus.

To cure or relieve disease has been, is, and will remain, for obvious reasons, the chief end of medicine—*sedare dolorem, divinum opus.* Therapeutics is commonly defined as the art of curing disease. It is still, indeed, very often, in fact too often, an *art,* if one understands thereby that it is dependent largely upon the personal and original objectives associated with it by the therapeutist as well as upon empiric and traditional practices, collated and handed down from each observer to his successors. It is tending, however, more and more to become a *science,* brought into action by rational application of the physiopathologic properties of therapeutic agents (physical, chemical, and biologic) to the morbid processes present. Under ideal conditions it consequently necessitates: (1) A complete, unassailable diagnosis; (2) a thorough knowledge of physical therapy, pharmacodynamics and biologic therapy; (3) rational correlation of these 2 groups of known facts.

While secondary to diagnosis, therapeutics constitutes, like the latter, in some of its aspects, a true science based upon the most accurate experimental data. This is exemplified in the specific serum treatment of diphtheria or of cerebrospinal meningitis, where the presence of one of these conditions has been bacteriologically ascertained. On the other hand, it descends, as does likewise diagnosis under many circumstances, into the most elementary empiricism, *e.g.,* when, in conformity with traditional usage, we prescribe a preparation of colchicum for a patient in an acute gouty attack, or Haarlem oil for a case of lithiasis.

* * *

A complete diagnosis—such as can, in the present state of medical knowledge, be promulgated only in a limited number of cases—comprises 4 component parts:

(1) A clinical picture: the *symptomatic diagnosis,* characteristic of the disease under consideration.

(2) A precise localization in some organ: the *anatomic diagnosis.*

(3) A rational understanding of the exact mode of production of the disturbances present: the *physiopathologic diagnosis.*

(4) A clearly defined cause: the *etiologic diagnosis.*

The following diagnosis is one of the most complete that can be made:

(1) *Stokes-Adams syndrome, i.e.,* attacks of slowing of the heart-rate (paroxysmal bradycardia), with syncopal or epileptoid manifestations (*symptomatic diagnosis*).

(2) Due to *auriculoventricular dissociation* (autonomous, independent or "anarchistic" functioning of the auricles and ventricles) (*physiopathologic diagnosis*).

(3) Dependent upon a *lesion of the bundle of His* (a neuromuscular bundle normally having to do with transmission of the contractile impulse from the auricle to the ventricle) (*anatomic diagnosis*).

(4) Of *syphilitic* origin (gumma) (*etiologic diagnosis*).

The therapeutic indications are here drawn mainly—as is generally the case—from the etiologic diagnosis (*syphilis*) and the physiopathologic diagnosis (*auriculoventricular dissociation*), and collaterally from the symptomatic diagnosis (paroxysmal bradycardia with syncopal attacks).

The *syphilitic origin* of the lesion supplies the specific indication of *antisyphilitic treatment,* applied chiefly by mercurial or arsenical medication or by a combination of these 2 groups of remedies, and collaterally by iodide or sulphur medication, etc.

The *auriculoventricular dissociation* will lead to the regular and systematic use of adrenalin, the experiments of Daniel Routier having shown that adrenalin will sometimes re-establish normal functioning in cases of defective action of the bundle of His.

The *symptomatic* datum, relating to the syncopal attacks, leads to the empiric prescription of diffusible stimulants, such as alcohol, ether, ammonium acetate, camphor in oil, caffeine, etc., when such an attack occurs.

The therapeutist may accordingly formulate as follows:

Diagnosis.—Stokes-Adams syndrome, due to auriculoventricular dissociation because of gumma of the bundle of His.

Treatment:

I.—(1) *One fortnight in each month:*

(*a*) Daily intramuscular injection of 1 or 2 c.c. (16 or 32 minims), increased gradually and *according to tolerance,* of the following solution:

℞ Hydrargyri iodidi rubri,
Potassii iodidi .... āā 0.6 gram (gr. x);
Aquæ destillatæ .... 30 c.c. (f℥j).
Ft. sec. art. et sterilisa.

(*b*) During the same period, the patient is to take ***morning, noon, afternoon,*** and ***evening,*** before meals, increasing gradually and ***according to tolerance,*** 1 tea-, dessert-, or tablespoonful of the following solution:

℞ Potassii iodidi .... 30 grams (℥j);
Aquæ destillatæ .... 500 c.c. (Oj).—S.

(*c*) Strict care of the mouth and teeth.

Three or four potassium chlorate lozenges to be used during the day.

(2) *In the succeeding fortnight:*

Adrenalin solution, 1:1000, 10 to 20 drops in a little sweetened water 3 times daily before meals.

(The 2 above prescriptions to be renewed according to indications.)

II.—*In the event of an acute attack:*

(*a*) Hypodermic injection of the contents of a 0.1 gram (gr. iss) ampoule of caffeine.

(*b*) A few dessertspoonfuls of the following:

℞ Ammonii acetatis .... 4 grams (ʒj);
Spiritus vini vitis .... 20 c.c. (f℥vj);
Syrupi ætheris (2 per cent.) .... 40 c.c. (f℥x).—M

III.—All excesses, alimentary, physical or other, to be avoided.

The therapeutic indications afforded by the diagnosis of the case may thus be said to be rationally met.

Obviously, the results of the treatment outlined are to be followed and checked, and the plan modified according to the course of the case.

Such is the form of the succession of mental processes to be gone through systematically in the preparation of a plan of treatment for the individual case.

The practitioner, to perform the office of a true therapeutist, should train his mind to ready operation and reflection along these lines.

* * *

The treatment above outlined suggests certain additional reflections:

Thus, it will be noticed that preference has been given to mercurial treatment rather than to arsenical medication, in particular

the newer preparations such as arsphenamin. This is because the latter compounds, while more potent, act more violently, and would thus expose the tissues of the bundle of His, through excessively rapid cure of the gumma present therein, to an unduly abrupt fibrous transformation of the bundle and favor the appearance of dangerous attacks of paroxysmal bradycardia.

The mercurial medication might be instituted in many other ways, whether by the mouth, skin, or rectum, each procedure having certain special advantages and disadvantages, which vary in different patients, according to their remoteness from the physician, their occupation, social status, family surroundings, etc. Indeed, it is the judicious appreciation of these various factors which will lead the physician to decide in favor of the most suitable mode of treatment, *i.e.*, that yielding the maximum of results with the minimum of drawbacks.

The iodide might similarly be ordered in a syrup, in special capsules, etc. The dose is to be increased according to tolerance, *i.e.*, avoiding coryza, acne and congestive manifestations.

All such mental processes ultimately become automatic in a practitioner trained in the practice of thoughtful therapeutics, particularly if he is desirous of escaping from the thraldom of the memorized, routine, dangerous form of elementary, "equation therapeutics," wholly symptomatic and empiric, *e.g.*, cough = codeine; diarrhea = bismuth; constipation = rhubarb, etc., the results of which might well be unfortunate in cough due to worms in a child, diarrhea due to botulism, or constipation due to appendicitis.

* * *

As a matter of fact, it is by no means always possible to work out so completely a rational plan of treatment. The nature and exact pathogenesis of the existing disturbances are frequently beyond our reach, as, for example, in psoriasis, exophthalmic goiter, gastric ulcer, etc. At times the diagnosis cannot, either for the time being or subsequently, be perfected beyond the mere observation of some obvious symptom, as in cryptogenic hemoptysis, fever of undetermined origin, insomnia of obscure causation, etc.; under these circumstances one is limited, while awaiting something better, to the prosecution of *symptomatic medication.* The efficacy of the latter will vary in accordance with the thoroughness of the physician's knowledge of the presenting symptom and with the degree to which the therapeutic measures adopted are based upon its physiopathologic mode of production.

In spite of all that may be said to the contrary, symptomatic treatment plays an important, in fact probably a preponderant, part in therapeutic practice, *specific forms of medication being as yet available for only a very restricted group of clinical entities.* A great mistake, and one which is very common and reprehensible, consists, however, in seeking specific medication of a symptom. This is the philosopher's stone of the modern therapeutic alchemists. There cannot be a specific medication for a symptom the specific causes of which are either unknown or manifold. One cannot lay too much stress on the correction of this mistaken speculation nor assert too positively that there is no specific treatment of cough, of fever, of hemoptysis, of albuminuria, of high blood-pressure, of leanness nor obesity, nor of angina pectoris, etc., but that the task of the therapeutist consists precisely in inquiring into the proximal or probable cause of the presenting symptom and directing all his energies to antagonizing this cause.

Thus, one commonly hears allusion made to hypotensor drugs, and for some, high blood-pressure = an iodide preparation, the high frequency current, etc.

No conception is more pernicious than this. True hypotensor medication consists of reducing a plethoric, obese patient; of bringing about sedation of the nervous system in a case of angiospastic erethism; of placing a nephritic on a suitable diet; of instituting antisyphilitic treatment in a case of specific aortitis, or of treating by reduction, hygiene, rest, and various auxiliary palliative measures the patient with arteriosclerosis and high blood-pressure who has passed into the stage of actual infirmity. Diagnosis and therapeutics, in close interrelation, should by all means work back to the proximal cause of the symptom and treat this cause insofar as such treatment is feasible in the present state of medical knowledge.

* * *

Lastly, the *anatomic* diagnosis may be the source of highly serviceable indications, generally operative in character. A diagnosis of effusion in a certain situation, as in pleurisy, pericarditis, ascites, etc., will generally indicate evacuation of the fluid. The anatomic diagnosis of a purulent collection, as in otitis, empyema, abdominal suppuration, perinephric abscess, etc., similarly demands incision. One need not emphasize the practical importance of a diagnosis of appendicitis. Many neoplasms of the viscera, especially those involving the gastrointestinal tract, are now accessible and removable. In short, there

is no doubt but that this mixed medico-surgical field is destined to undergo progressive extension in the future.

* * *

Therapeutic indications should, accordingly, be laid down more or less accurately on the basis of:

(1) *Knowledge of the underlying cause of the disease—the* **etiologic diagnosis,** *e.g., syphilis, tuberculosis, malaria, acute rheumatism, gout, etc.*

(2) *Knowledge of the* **physiopathologic mode of production** *of the existing disorder or of its principal symptoms, e.g., sympathetic neurosis and dysthyroidia of exophthalmic goiter; angiospastic origin of certain cases of high blood-pressure; reflex, e.g., helminthic origin, of some cases of inveterate cough, etc.*

(3) *Localization of the existing lesions* **(anatomic diagnosis),** *which will sometimes yield definite operative indications.*

(4) *Lastly, the symptoms—***symptomatic diagnosis***—which frequently necessitate some special treatment by reason of their intensity (pain or dyspnea), seriousness (hemoptysis or hematuria), or obstinacy (cough or fever). The better the knowledge obtained of their exact physiopathologic mode of production, the greater the chances of successfully combatting them.*

The knowledge of the ancients along these lines was largely confined to a fragmentary conception of the last 2 groups of indications, symptomatic and anatomic. The etiologic (specific) and physiopathologic components were more recently acquired, having come to light mainly through the revolutionary changes which resulted from the discoveries of Pasteur and from the physiopathologic, functional orientation introduced by Magendie and Claude Bernard, which gradually took the place of the pathologic, lesional method of Laennec. Medicine has thus undergone a complete transformation. Previously a "meditation on death," it has actually become a "struggle for life."

* * *

To review, even briefly, the evolution of therapeutics through bygone ages would be to conduct a singularly searching inquiry into the history of human thought. One is strongly tempted to present such a review. To do so, however, would involve an undue excursion beyond the limits decided upon by the author and would be devoid of any marked interest in respect of the intended aim of the work.

Let it be remarked, however, in a general way, that the aggregate of therapeusis up to the nineteenth century may be summed up thus: A pile of rubbish and a handful of jewels. The pile of rubbish consisted of an extravagant accumulation of the most foolish theories and of the most stupid and at times monstrous practices. The handful of truths consisted of the admirable compend of the majority of substances, mineral and vegetable, capable of producing some action or other on the human system—in short, the classic pharmacopeia, many highly judicious observations regarding diet, and a number of minor surgical procedures.

As for the pharmacopeia, one cannot set too high the debt we owe the ancients. It may be said that no really new vegetable drug has been found for over a century. The discovery of the soporific and analgesic properties of opium is in itself deserving of everlasting gratitude. In perusing the old Arab treatises and formularies of the eleventh and twelfth centuries, one is dumfounded to find therein not only most of the so-called galenic remedies, with precise and almost perfect descriptions of the modes of preparation (robs, opiates, electuaries, tinctures, suppositories, etc.), but also quite acceptable clinico-symptomatic classifications, as exemplified in the group-terms soporifics, purgatives, diuretics, carminatives, tonics, astringents, and healing agents. Let one recall the thorough studies of Withering on digitalis, of Sydenham on opium and its preparations, the empiric use of cinchona in fevers, etc. Are these not thoroughly deserving of gratitude on our part? What innumerable observations are represented in so great a sum of useful data!

The ancients were masters of physical therapy. There is no doubt that, *e.g.*, in myotherapy (gymnastic exercises and massage), in hydrotherapy, and in heliotherapy the Greeks and Romans were incomparably superior in their practices to the physicians of but 40 years ago, and probably even to the majority of practitioners at the present time. Hippocrates was already bathing cases of pneumonia; Galen employed baths in febrile disorders, while Asclepiades devised over 100 varieties of baths and was already practicing exercise therapy by means of carefully regulated walks over inclined surfaces.

Dietetic measures were sometimes applied in a highly intelligent manner. Starvation, diets, and mineral water cures really served as the solid foundation of an otherwise markedly disconcerting system of therapeutics. One need but recall the dietetic precepts, still lauded even to excess, of the school of Salerno.

As for minor surgery, we have introduced relatively little that is new. Cupping, venesection, various forms of counterirritation, and

enemas were all in current use. Abscesses were incised and drained. Hippocrates already incised for empyema and abscess of the liver. Trephining, as is well known, was performed even in prehistoric times. The practices of Ambroise Paré also prove enlightening.

All these remarkable acquisitions, however, occur in scattered notes or are wrapped up in an extraordinary tangle of theories, systems, practices and doctrines, each more cabalistic than the others. It is especially this form of unreasoning mania or delirium which, leading medicine away from the two luminous paths which the Greeks had begun to follow, *viz.*, observation and experimentation, caused it to stray into the dark labyrinth of mysticism and scholasticism. The formula of Abracadabra, the astrologic reveries of the Assyrians and the Medici, the crude theory of the similars of Paracelsus,* the theory of peccant humors, leading to the purgative and blood-letting craze of the pedants of the seventeenth century, and the Aristotle-like logorrhea of Diafoirus are examples of these vagaries, to which an unlimited number of others might be added.

Yet, we should not become too inflated with our own achievements. The present period, while actually very rich, as we shall see, in new acquisitions and substantial therapeutic truths, is none the less beset with fallacious theories and more or less absurd and abstruse systems. To avoid hurting anyone's feelings, no names will be mentioned. I can truthfully record—and my friend Desfosses could bear witness to it—having met with a colleague, intrinsically honest, who claimed to have cured a case of cancer of the tongue by means of infusions of a plant the leaves of which, selected by him, precisely resembled the tongue of the patient. The same colleague raised strenuous objections to the use of saline solution in a typhoid case exhausted by continuous hemorrhage; not for any reasons worthy of discussion, such as the possibility of a rise of blood-pressure, of chloride retention, etc., but because "the patient being a naval officer, you understand; sea water is salty, you understand." Alas, we understood only too well. Stupidity, like charlatanism, is everlasting. Diafoirus and Tabarin are imperishable.

As above suggested, let us remain duly modest. But let us not succumb to the wiles of the orators tirelessly expatiating on the theme: *Nihil sub sole novi.* Without overlooking the merits of the ancients, let us not overlook our own. Let us preserve a deep sense

* "The fundamental principle of medicine," he taught, "is to administer to each organ that which is morphologically similar to it." Thus, lemons being heart-shaped, they may appropriately be given in heart disease..... A strange application of the principle which later received such prominent recognition: *Similia similibus curantur.*

of the meaning of tradition, but let us also entertain that of evolution. Let us not believe that the world saw the light at the time of our birth; and let us not believe that it has made no progress since.

Whether we are better, more intelligent or happier than the ancients is very doubtful, or at least open to discussion. But that a locomotive runs more rapidly than the ancient chariot; that telegraphy propagates news infinitely better than signal fires on the hilltops, and that diphtheria antitoxin checks in a few hours a disease formerly very often fatal, are obvious facts. Our means of action, at least of a material nature, are incomparably superior to those of earlier generations.

It can undoubtedly be maintained that an expert practitioner of the time of Pericles, even with the limited means of diagnosis and treatment then available, obtained better results than would a lunkhead amid all the valuable resources now at hand. But in the aggregate, the therapeutic results now procured are incomparably superior, as shown in the marked reduction of morbidity and mortality and the corresponding increase in the average span of human life.

* * *

In the course of the nineteenth century, and more particularly in its second half, therapeutics underwent changes that may well be characterized as prodigious, as a result of the general development of science—physical, chemical, and biologic—and more particularly by reason of the following 6 factors:

(1) The bacterial origin of disease, which permitted investigation of the *specific cure of infectious disorders,* in some instances successful in discovering the desired curative agent. Serum therapy and bacterial vaccine therapy are entirely new conceptions.

(2) The investigations in *physiologic pathology,* working progressively deeper, which have led to the institution of actual experimental therapeutics, thanks to laboratory methods permitting a steadily increasing permeation of clinical work with accurate methods of examination, such as those of hematology, serology, radiology, graphic procedures, etc. The physiopathologic orientation of therapeutics has served as a foundation for incalculable progress. Medical thought has turned from the tissue lesion to the functional change.

(3) *Synthetic pharmacodynamics,* the enormous strides of which, in conjunction with those of general chemistry, have supplied us with a multitude of products of which some are really new (anilin derivatives, such as antipyrin, pyramidon, etc.), while the remainder,

though in the last analysis merely more or less fortunate variations on earlier themes (organic arsenical compounds, arsphenamins, etc.), are none the less agents possessed of power previously unknown.

(4) The recasting of *physical therapy* through the rational and systematic application of a host of physical agencies forgotten, unknown or overlooked by the preceding medical generation, *viz.*, hydrotherapy, heliotherapy, mechanotherapy, electrotherapy, etc.

(5) The discovery of *radiotherapy*, of which at least two modalities, *Röntgen therapy* and *radium therapy*, are already in daily use, sometimes with remarkable results, as in the treatment of new growths.

(6) The *advances in surgery*, thanks to the antiseptic and aseptic methods, which have enabled the surgeon to deal freely and directly with the most deeply situated organs. The whole of visceral surgery, with its outstanding record and further great promise for the future, is a modern acquisition.

* * *

The present orientation of medical thought in physiologic pathology implies as corollary a functional therapeutics featured by systematic training to a desired end, by motion and by active faith and life, diametrically opposed to the skeptical, fatalistic therapeutics of inertia and helplessness too often the result of the pathologic type of training.

The 3 fundamental principles may be condensed as follows:

(1) *Any organic system, healthy or diseased, possesses a varying degree of reserve functional power, in inverse proportion as such system is congenitally more or less feeble or more or less impaired by disease.*

(2) *Gradual training of the corresponding function, whether by purely physiologic means (e.g., progressive myotherapy for the heart, graduated diet for the digestive tract, etc.), or by pharmaceutic means (e.g., phosphoric acid for psychasthenia, organotherapy in glandular insufficiencies, etc.), may increase this reserve power and in general reduce the organic weakness.*

(3) *In addition, one may sometimes note objective evidences of a compensatory and life-saving hypertrophy.*

In brief, **any diseased organ tends to persist in its function,** either through a favorable compensatory hypertrophy (*e.g.*, in hepatic cirrhosis), or through correction of cellular degeneration (as in dyspepsia and enteritis), or through a reactive overfunctioning of synergistic systems (compensatory hypertrophy of the heart in interstitial nephritis, in arteriosclerosis, etc.).

It is clearly in this direction, toward this object, that therapeutics should be oriented.

* * *

The very profusion and plethora of therapeutic measures and agencies presents, however, certain drawbacks.

On the one hand, each of these divisions of therapeutics is so chock-full, so exuberant that it will absorb all of the mental sap of one individual. There are serotherapeutic, physiotherapeutic and pharmacodynamic specialists. This is quite natural; but nothing is more dangerous than if each of these specialists is not actually aware of the limitations of his particular field. All specialists exhibit a tendency, in many instances irresistible, to bring the whole of medicine, either willingly or forcibly, within the narrow confines of their specialty. There is the well-known instance of a pharmacodynamist, a most distinguished man and one to whom we are indebted for a very remarkable contribution to therapeutics, but who, carried away by his subject, claimed in his later years that he could cure practically all diseases with phosphoric acid. French medical science is mourning the loss (!) of an official venereologist who declared that appendicitis was amenable to antisyphilitic treatment. The use of high frequency has led to applications and theories in which naïveté vies with quackery. For many (laboratory) clinicians, the whole of internal medicine and the whole of therapeutics are bound up with the culture tube and hypodermic syringe.

Let us not force ourselves beyond our respective accomplishments, and let each one remain in his allotted field—the experimenter in his laboratory, the clinician at the bedside of his patient, both, however, constructing as many bridges as possible to the opposite banks of the dividing stream. Therein lies every advantage for both of them, and even, more particularly, for the patient . . . the one mainly concerned.

At the opposite pole, practitioners whose knowledge is great in breadth rather than in depth are indulging in veritable therapeutic debauches, staggering in their eclecticism.

Thus, I followed at some distance, with one of these neotherapeutists, a case of typhoid fever of mild type. A book would hardly contain the number of therapeutic agents with which the unfortunate patient was dosed. Quinine, antipyrin, urotropin, lactic ferments, benzonaphthol, adrenalin, camphor in oil, opium, barbital, belladonna, various colloidal agents (silver, gold, and platinum), sodium salicylate, strychnine, sparteine, lotions, enemas, typhoid culture in-

jections, ozonization, saline solution, sea water, etc., were combined, substituted, and superimposed in an inconceivable admixture. None was absurd when taken alone, but their accumulated imposition would have been attended with decided risk, had the patient and nurse not disposed of nine-tenths of them in ways not originally intended.

In this connection sins of commission and of omission are both possible, either through blind audacity or unduly far-seeing pusillanimity.

Herein, as in all human things, lies a problem of selection, of measurement, of equilibrium and of harmony. Perfect treatment of a case is a kind of masterpiece which is hard to define, and it is precisely in this that therapeutics remains an art, *viz.*, in the judicious selection of the main indications and of the means of meeting them with the maximum of results and the minimum of inconvenience and effort.

Finally, there are some theorists and leading lights who speak only of "radical therapeutics" ["grande thérapeutique"], doubtless by way of contrast with the common, ordinary, handed-down therapeutics, regarded as vulgar and obsolescent by these ideologues, whose grandeur holds them to the border-line of theory, a thing too often misunderstood and misused, if the truth were known. To relieve or cure a consumptive by opportune application of the time-honored therapeutic measures; to maintain in a state of perfect balance and preserve to the extreme limit of old age an established case of heart disease through proper dietetic regulation, systematic physical measures, and discreet drug treatment; to relieve a patient of obstinate and dangerous constipation by means of a carefully thought-out diet, suitable exercises, and the auxiliary use of some drug—these are matters to be left to the "vulgum pecus," the "medical practitioner;" only the great problems of medicine are worthy of the endeavors of these superior minds. The shade of Pasteur haunts them. "Whether burning or freezing, his image ceaselessly obtrudes in their thoughts." Their retorts too often yield but distorted ideas. The thrice famous author of certain investigations on old age found the elixir of long life . . . in dog dung, and while testing his theory . . . died, like his contemporaries, at the close of the sixth decade.

Others, though some of them remarkable diagnosticians or pathologists, look upon the therapeutists with the haughty disdain of the physicians of old for the barbers, who carried out their directions; they deem therapeutics an inferior grade of art to be left to the quacks, masseurs, cuppers and herbalists. One of my old chiefs took occasion to mention to me that "the mediocrity of a Faculty is pro-

portionate to the number of theses on therapeutics presented before it." There is also this rather crude aphorism: "Therapeutics! Either a patient is suffering from 'croakitis' and we are helpless, or he is suffering from 'non-croakitis,' in which case he gets well of his own accord!" Implicit training in pathology, too much autopsy work, have thus distorted too many minds, sometimes bright—though narrow—ones, the skeptical influence of which proved disastrous in the first half of the nineteenth century, completely imbued as it was with organicism. There still exist many examples of this type of mental tendency.

My brother practitioner, there is no procedure, however humble in appearance, which is not of noblest essence if it brings relief or cure to a human subject! It is here, indeed, that "the end justifies the means."

The science and art of curing disease constitute, perhaps, the highest manifestation of humanity. The ancients made of them an attribute of divinity.

* * *

When a generation of medical men has conquered diphtheria, cerebrospinal meningitis, etc.; has brought about retrocession of many neoplasms; saved millions of cases of appendicitis from death; manufactured agencies of previously unsuspected power against pain and sleeplessness, and opened to therapeutics incomparable vistas—how can such a generation still contain so many skeptics, unless it be on account of the obvious phenomenon that individuals see in current events only what they carry within themselves, and that of the two sides of a medal, one person will be irresistibly attracted by the one side and another by the other. The pessimist replies to the joyous peals in celebration of the victories over diphtheria, appendicitis, and numerous instances of neoplasm by a funereal chant on the many cases of cancer and tuberculosis that have so far proven incurable and on certain deplorable cases still too often met with in the clinics.

Pessimism promotes defeat, for pessimism engenders further pessimism and proves its truth through its pessimism *per se,* promoting skepticism, despair, lack of will-power to act, and therapeutic helplessness.

This brings us to one of the noblest as well as the most difficult aspects of therapeutics—that of the mental factor in the art of curing disease.

Man is capable of more than he knows.—
CLAUDE BERNARD.

In the preceding pages have been presented a few side lights on ponderable therapeutics, if I may be permitted this expression, *i.e.*, on therapeutics dealing only with material, concrete, tangible, measurable, or to a degree palpable agencies—that form of therapeutics alone deemed scientific in the present state of human knowledge.

Any practitioner long engrossed in the care of human ills will concede, however, that aside from—or, I make bold to say it, *above*—this ponderable, material and traditional form of therapeutics there exists an imponderable, immaterial, in a sense "fluid" form of treatment which the therapeutist, either consciously or unconsciously, but usually without any special endeavor, brings into play.

Whether, because of an innate desire to remove all mystery from the phenomena presented before our necessarily limited power of observation, this "psychic," impalpable, immeasurable action be designated as "suggestion," "psychotherapy," or even "quackery," such labels do not supply any valid or at least sufficient explanation of the facts themselves.

And these facts are as follows: Confining ourselves to the therapeutic field—though the facts do not apply alone to this field—a dominating personality exerts over a weaker personality, through its presence alone and the sole power of its affirmation, gesture and verbal expression, a wholesome or harmful influence, awakens or destroys in the weaker personality the vital energy, hope or despair, the desire to live or the obsession of death, and favorable reactions or pernicious depressions.

What therapeutist worthy of the name will deny these facts? Are there not familiar to all the names of physicians of eminent repute—the latter, perhaps, because of an astounding vastness of knowledge, and sometimes even because of thoroughgoing researches in certain lines—yet whose practical, therapeutic activities appear to all, at the bedside, of doubtful value or even prejudicial? On the other hand, who is not familiar with certain conscientious practitioners, scientifically shallow but sympathetically profound, whose devotion, goodness and active faith are such that their presence alone is enough to work miracles?

Here the fatal word "miracles" has been let loose—likely to bring down upon one's head the severest of anathemas and the most fearsome reprimands.

And, indeed, the doctrine which would make of therapeutics an act of faith would be pernicious, unscientific and eminently a step backward. Our present knowledge of curative treatment is too firmly buttressed and on too concrete a foundation for us to feel any apprehension of such a retrograde step. No such failure is to be feared in the period which has conquered by the most objective methods such diseases as diphtheria, cerebrospinal meningitis and appendicitis; has checked syphilis, has attenuated tuberculosis, and has produced incomparably effective analgesic remedies.

But is it scientific absolutely to shut one's eyes and stop one's ears against such phenomena as charlatanry, miraculous cures, etc.? Are there not therein some facts worthy of study? Is one to think that he has fulfilled his entire duty as a man of knowledge by turning away from these practices with horror and contempt, or by being content to apply to them the miserable little label "suggestion," which is almost devoid of sense since, on the whole, it merely expresses the fact itself, like the word cephalalgia applied to a patient with headache?

No, there exists in this connection a whole group of manifestations, not disconcerting, but yet mysterious and unaccountable, or nearly so, in the present state of our knowledge, and which may be summed up thus: Some patients suffering from disorders which they mistakenly or rightly consider, or which are considered by their associates, to be rebellious or incurable, find their symptoms disappearing under the influence of practices that are inactive in a material way, such as prayers, various images or idols, ablutions at shrines reputed to be curative, etc. The only common feature in all these phenomena is that an individual who has lost all hope of recovery and is literally in despair regains hope and faith in recovery as a result of some non-material influence and gets well from this fact alone.

The therapeutist cannot disclaim all interest in these observations, and while unable at present to account for them in a manner really satisfactory from the scientific standpoint, he should, nevertheless, draw from them a conclusion of great practical value, *viz.*, that *belief in recovery is sometimes, indeed frequently, an essential factor in such recovery.* Let each one draw therefrom the conclusions which are justified in the individual case.

The efficient practitioner will bring into play, often without knowing it, those obscure and secret forces which act on the sensorium of his patients, and will in doing so improve their health and invigorate them in body as well as in spirit.

The favorable influence of confidence cannot be expressed more simply and directly than has been done by Helvetius (father of the philosopher of the same name) in the following lines:

"Confidence contributes greatly to the recovery of patients and those who are lacking in it are commonly in states of nervousness which constitute an obstacle in the way of restoration to health and the action of remedies. I think the physician should discontinue seeing a patient whom he finds in this state of mind. . . .

"At such a time the physician should give way to another, certain to be thus better off, as will likewise be the patient. On the other hand, when the patient exhibits a blind confidence in him, the physician must respond with a double measure of attention, care and vigilance, in order to procure for the case a prompt and perfect recovery."*

* * *

But little change would seem necessary to make the following passage from Boutroux quite applicable to the art of curing disease: "Effective action in this world depends neither on the unreasoning and irrevocable impulse of passion, nor on the contemplative train of thought of the dreamer who soars above the multitude, but on the harmonious and indissoluble union of reflection and endeavor, of faith and of thought, of love and of energy."†

The science of diagnosis and that of therapeutics are mastered by study and meditation.

The art of therapeutics is partly an individual gift which may be developed by practice and endeavor. The personal authority which breeds confidence, the affective pity which the keen senses of the sufferer observe issuing from beneath the roughest exterior, these are natural gifts which are very hard to cultivate in a person who does not possess them.

This subject goes far beyond the intended limits of the present introduction; it constitutes, on the whole, that of the action of imponderables in therapeutics. We shall have occasion to revert to it many times in the course of the present work.

[* "Traité des maladies les plus fréquentes et des remèdes spécifiques pour les guérir," by M. Helvétius, Physician to H. R. H. Mgr. le duc d'Orléans, Trévoux, 1722.]

† Discourse on the occasion of the reception of F. de Curel in the Académie, May 8, 1919.

Proper clinical therapeutic management requires:

(1) *A* **correct and complete diagnosis,** *including the cause, physiopathologic mode of production, and localization of the disease, at least insofar as is possible.*

Description of the procedures leading up to such a diagnosis has been the aim of the author's work on CLINICAL DIAGNOSIS *(q.v.).*

(2) **Accurate knowledge,** *sufficient in detail, of the* THERAPEUTIC AGENCIES *now available.*

Presentation of this knowledge will be our purpose in the first 2 parts of the present work:

I. THERAPEUTIC AGENTS.

II. THERAPEUTIC PROCEDURES.

(3) **Adaptation,** *rational or empiric, of the available* THERAPEUTIC MEASURES *to the* DISORDERS *to be combated.*

The diagnosis supplies the indications for the treatment; clinical therapeutics is concerned with meeting them.

In practice the therapeutic problem presents itself in 2 concrete forms:

There may be a symptom to be overcome; it may either be the predominating manifestation (obesity) or an obstinate (cough) or dangerous one (hemorrhage). This will be taken up in Part III:

III. THE TREATMENT OF SYMPTOMS.

There may be a definite and known disease to be treated (pulmonary tuberculosis, visceral syphilis, rheumatic endocarditis). The treatment of the commoner disorders will be discussed in Part IV:

IV. THE TREATMENT OF DISEASES.

PART I.

THERAPEUTIC AGENTS.

Medicinal Agents.

GENERAL CONSIDERATIONS.

In spite of the large number of drugs theoretically available, only a relatively limited number of them are actually in current use. The latter alone will be considered in the short, yet fairly substantial account of the medicinal agents which I propose to give. Sydenham was in the habit of saying that all the useful drugs could be contained in the knob of his cane; despite all advances made in the curative art, there are about 20 drugs which may be *sufficient* for the prosecution of almost the whole of drug therapy, or which are at any rate *indispensable* in everyday therapeutics and which must of necessity be thoroughly learned. These substances in particular—opium, belladonna, arsenic, mercury, digitalis, antipyrin, salicylates, etc.—will be found concisely described; some drugs used more exceptionally will, however, also be briefly mentioned.

A rather suggestive contribution as regards the choice of the drugs to be employed in current practice is afforded in certain statistic data from the Pharmacie centrale des Hôpitaux presented by Grimbert (Acad. de méd., Apr. 29, 1919), relative to the fluctuations in consumption of the principal drugs used in the hospitals during the decennial period, 1907 to 1917. This contribution may be summarized as follows:

I.—**New Drugs:**

A.—*Accepted:* Novocaine (1908), electrically prepared colloidal silver (1909), arsphenamin (1911), neoarsphenamin (1912), and galyl (1915).

B.—Still *on trial:* Lactic ferments (liquid cultures), injectable organ extracts, and a few colloidal metals.

II.—**Old Drugs**, which may be grouped as follows according to their rate of consumption in successive years:

"(1) STATIONARY: *Most of the time-honored remedies.* Some have not changed for 20 years: *Morphine hydrochloride* (20 kilograms); *cocaine hydrochloride* (11 kilograms); *sodium sulphate* (2000 kilograms); *magnesium sulphate* (4000 kilograms); *sodium bicarbonate* (3000 kilo-

grams); *calcined magnesia* (200 kilograms); *bismuth subnitrate* (500 kilograms); *sodium salicylate* (350 kilograms); *silver nitrate* (60 kilograms); *kermes mineral* (10 kilograms); *white oxide of antimony* (10 kilograms); *rhubarb* (80 kilograms), and *senna* (250 kilograms).—Others have not changed for 10 years: *Opium* (100 kilograms); *laudanum* (300 kilograms); *quinine sulphate* (50 kilograms); *caffeine* (15 kilograms); *pyramidon* (70 kilograms); *naphthol, benzonaphthol, chloroform, sodium cacodylate* (10 kilograms), and *arrhenal* (4 kilograms).

"(2) DECREASING RAPIDLY: *Antiseptics* in general, except formaldehyde (mercury bichloride, boric acid, potassium permanganate, phenol, phenyl salicylate, iodoform); *iodides* (350 kilograms) and *bromides* (650 kilograms).

"DECREASING SLOWLY AND STEADILY: *Hydrogen dioxide, trional* and *sulphonal, glycerin* (20,000 kilograms); *codliver oil* (10,000 kilograms), and *extract of cinchona* (200 kilograms).

"(3) INCREASING RAPIDLY: *Neoarsphenamin* (8500 doses in 1912; 130,000 doses in 1918); *acetylsalicylic acid, formaldehyde, hexamethylenamin* (200 kilograms); *theobromine* (180 kilograms); *barbital* (30 kilograms); *tricalcium phosphate* (500 kilograms), and *iodotannic syrup* (28,000 kilograms).

"INCREASING SLOWLY AND STEADILY: *Collargol* (18 kilograms); *protargol* (18 kilograms); *ether; sodium benzoate* (450 kilograms); *tincture of iodine* (100 kilograms), and *injectable organ extracts* (12,000 ampoules in 1913).

"(4) SHOWING IRREGULAR FLUCTUATIONS: *Methyl salicylate, calcium glycerophosphate, bismuth subgallate, calomel,* and *extract of opium.*"

* * *

Without going into unnecessary detail, let us recall the general evolution of chemotherapeutic pharmacodynamics, exactly parallel as it is to that of general chemistry, of which it constitutes but a single division. The following 4 stages in this evolution may be enumerated:

First Stage.—Empiric.—Discovery through millennial empiricism of the active natural drugs—opium, cinchona, belladonna, digitalis, etc.

Second Stage.—Analytic.—Discovery of the chemical features characteristic of active drugs; isolation of the alkaloids, such as quinine, strychnine, etc. Pharmacodynamic action is considered the result of a specific molecule.

Third Stage.—Analyticosynthetic.—Pharmacodynamic action depends essentially upon a portion of the molecule, *viz.*, an atom or a group of

atoms: Analysis and synthesis of alkaloids. This is the extremely fruitful period of the synthesis of anesthetics, of the derivatives of anilin (antipyrin and its derivatives), of the hypnotics other than opium, of the antipyretics other than quinine, of the diuretics of the xanthin series, of cocaine, of adrenalin, of the organic derivatives of arsenic (methylarsenates, arsphenamins, etc.).

Fourth Stage.—Physicochemical.—Pharmacodynamic properties no longer appear to be dependent upon certain atoms or groups of atoms, but upon the condition of such atoms or groups of atoms, such conditions conferring upon them special properties. Colloid therapy and various forms of radiotherapy are opening new fields to therapeutics.

* * *

In other words, drug action has been successively referred from the natural drug to a chemical group consisting of a definite molecule; from the molecule to a fragment of molecule consisting of an atom or group of atoms, and from the atom or group of atoms to the condition of such atom or group of atoms.

For this reason the distinction between drug therapy and physical therapy will grow constantly less clear-cut.

Nothing is more soothing and re-assuring to the therapeutist than occasionally to take a glance backward before turning toward the future; this is the best way to guard against skepticism and illusionism, those two equally fearsome stumbling-blocks to active therapy. It is in this sense that the foregoing apparently theoretic introduction may, in the author's opinion, have a really practical bearing.

CLASSIFICATION OF THE MEDICINAL AGENTS.

In the present state of therapeutics, three forms of classification may be adopted in the description of medicinal agents:

The *alphabetic classification,* followed in dictionaries and formularies; this is convenient after the fashion of a directory, but is not a clinical classification, and hence has been discarded herein.

The *chemical classification,* theoretically perfect, is for practical purposes worse and still less clinical than the preceding.

The *pharmacodynamic classification* consists in grouping drugs according to their dominant therapeutic action, *e.g.,* analgesics, type drug antipyrin; heart-tonics, type drug digitalis; antisyphilitics, type drug mercury, etc. This classification has been availed of herein because there is no doubt that it is the one best adapted for clinical needs,

Various criticisms of it may be made. Thus, many drugs, such as the iodides, are hard to classify. Others act in several ways, *e.g.*, the arsenicals, acting as alteratives and also as antisyphilitics, etc. An unobjectionable classification would be the certain hallmark of a perfect science, and we are far from such perfection.

The succeeding classification has been adopted, incomplete and open to objection as it is, because, from my viewpoint, it has the great advantage of affording a system of grouping appropriate for the later description of symptomatic and specific medication, *i.e.*, of the treatment of symptoms and of diseases, which, after all, is the exact purpose intended. Further, this description will necessarily be later rounded out along with the therapeutics of symptoms and diseases.

It should be noted that the discussion herein has been restricted to the main drugs, the medicinal agents which are in common use and unquestionably indispensable in everyday therapeutics. It is open to each reader, who is indeed urged to do so, to make any addition to, deletion from, or modification of the list which his personal experience may suggest. But enough stress cannot be laid on the point that too great an abundance is not a true abundance. However remarkably versatile the therapeutist may be, the number of drugs the use of which, as to dosage and clinical indications, he will really have mastered, will always be rather limited. It is better to have at hand a few certain and well-tested therapeutic devices than a large number of uncertain ones. In spite of the obvious advances in pharmacology, particularly in the course of the last 40 years, the therapeutic symphony is, on the whole, but a series of variations written on the basis of a rather limited number of actually original themes.

MEDICINAL AGENTS.

A.—Drugs acting selectively on a definite organic function.

I.—Circulatory Drugs:

1. *Cardiac remedies:* Type drug, *digitalis.*
2. *Vascular remedies:* Type drug, *adrenalin.*
3. *Diuretics:* Type drug, *theobromine.*
4. *Hematinics:* Type drug, *iron.*

II.—Urinary Drugs:

. *Antiseptics:* Type drug, *hexamethylenamin.*

III.—Respiratory Drugs:

1. *Oxygen therapy: Oxygen.*

2. *Expectorants:* Type drug, ***turpentine.***
3. *Bechics:* Type drug, ***opium and its derivatives.***

IV.—DIGESTIVE DRUGS:

1. *Alkalies:* Type drug, ***sodium bicarbonate.***
2. *Purgatives:* Type drug, ***sodium sulphate.***
3. *Emetics:* Type drug, ***ipecacuanha.***

V.—NERVINE DRUGS:

(a) *Nerve-depressants:*

1. *Antispasmodics:* Type drug, ***belladonna.***
2. *Sedative antispasmodics:* Type drug, ***bromides.***
3. *Analgesic antipyretics:* Type drug, ***antipyrin.***
4. *Simple hypnotics:* Type drug, ***chloral hydrate.***
5. *Analgesic hypnotics:* Type drug, ***opium.***
6. *Anesthetics:* Type drug, ***ether.***

(b) *Nerve-stimulants:* Type drug, ***strychnine.***

(c) *Nerve-tonics:* Type drug, ***phosphorus derivatives.***

VI.—OPOTHERAPEUTIC SECRETORY DRUGS:

1. *Endocrin:* Type drug, ***thyroid.***
2. *Exocrin:* Type drug, ***pepsin.***

VII.—DRUGS INFLUENCING METABOLISM:

1. *Against gout:* Type drug, ***colchicum.***
2. *Uricolytics:* Type drug, ***piperazin.***

B.—Drugs acting selectively on infectious and parasitic conditions:

I.—SPECIFICS: *Serum therapy:* Type drug, ***diphtheria antitoxin.***
Vaccine therapy: Type drug, ***antityphoid vaccine.***
Bacterial therapy: Type drug, ***lactic ferments.***
Chemotherapy: Type drug, ***mercury as antisyphilitic.***

II.—NON-SPECIFICS: *Antiseptics:* Type drug, ***hexamethylenamin.***
Antipyretics: Type drug, ***antipyrin.***
Leucogenic agents: Type drugs, ***colloidal products.***

DRUG DOSAGE AND INTOLERANCE.

Some persons, as is well known, show a special susceptibility to untoward effects on the part of certain drugs. Hypersensitiveness to iodine, manifested in coryza, lacrimation, headache and skin eruptions after ingestion of even moderate doses of an iodide, is a most common occurrence. The usual procedure in such a case has been to discontinue the drug, discard it, and label the condition one of "idiosyncrasy," which means nothing.

From my viewpoint, this is a mistaken course to follow.

When we prescribe some drug for a patient, one of 3 things may happen: Either the results obtained are precisely those desired and expected; everything is going well, and there is nothing to do but continue the medication. Or, the results may be nil or inappreciable; the dose may then be increased, but very often it is better to turn to some other drug; the patient fails to respond to the substance prescribed, is insensitive to it, and there is no use in continuing with it. Lastly, the reaction may be excessive, being marked by unpleasant or even harmful manifestations; the patient is hypersensitive; there is thus available a valuable medicinal agent, of enormous potency and to which the patient will certainly react; there remains but to ascertain the proper dose.

In a new case I prescribe iodides to a daily amount of 0.5 gram (7½ grains), to be increased later according to indications and tolerance. If the patient exhibits intolerance even with this initial dosage, instead of discontinuing it I prescribe it systematically in the following way: One powder of 0.1 gram (1½ grains) is dissolved in 1 liter of water, forming a 1:10,000 solution, and an ascending daily dosage of 2 teaspoonfuls (0.001 gram—1/65 grain), 2 dessertspoonfuls (0.002 gram—1/32 grain), 2 tablespoonfuls (0.003 gram—1/21 grain), etc., is ordered until the slight physiologic reaction which points to approaching saturation is reached. If these amounts are ineffectual, a 1:1000 solution is substituted, the above doses corresponding then to 0.01, 0.02, 0.03, etc. (1/6, 1/3, ½ grain, etc.) *per diem.*

There is thus generally, if not always, obtained a desensitization which is one of the most certain tests of a curative action upon the morbid condition present, the hypersensitiveness of which to the drug selected was itself precisely one of its physiopathologic attributes. This question is connected with the much more general one of humoral equilibrium and its disturbances, to which we shall have occasion to refer in greater detail in certain other sections of this work (see Colloids, Non-specific, anti-infectious medication, etc.).

MAXIMUM DOSES OF DRUGS FOR ADULTS.*

	Maximum Single Dose		Maximum in 24 Hours	
	Grams	Grains or Minims	Grams	Grains or Minims
Acetanilid	0.3	5	1.5	22½
Acetylsalicylic acid	1	15	6	90
Aconitine	0.0002	1/325	0.0005	1/130
Amyl nitrite	0.2	3	1.4	22
Apomorphine hydrochloride	0 015	¼	0.015	¼
Arecoline hydrobromide	0.0005	1/130	0.0015	1/48
Arsenic trioxide (arsenous anhydride)	0.005	1/12	0.015	¼
Atropine	0.0005	1/130	0.001	1/65
" sulphate	0.001	1/65	0.002	1/32
Betanaphthol	1	15	3	45
Caffeine	0.5	7½	2	30
Calomel	1	15	1	15
Chloral hydrate	4	60	·12	180
Chloroform	0.5	5½	3	32
Cocaine hydrochloride	0.05	¾	0.15	2½
Codeine	0.05	¾	0.2	3
" phosphate	0.075	1¼	0.3	4½
Codliver oil with phosphorus (1 : 20,000)	20	300	40	600
Colchicine	0.002	1/32	0.004	1/16
Creosote	0.5	7½	1.5	22½
Croton oil	0.05	1	0.1	1½
Cupric sulphate	0.75	12	0.75	12
Digitalin, French ("digitaline cristallisée")	0.0003	1/200	0.001	1/65
Guaiacol	0.5	7½	1.5	22½
" carbonate	0.5	7½	2	30
Hydrastine	0.1	1½	0.3	4½
Hydrastinine	0.05	¾	0.15	2½
" hydrochloride	0.05	¾	0.15	2½
Hydrocyanic acid (2 per cent.)	0.1	1½	0.5	7½
Iodoform	0.2	3	1	15
Lead acetate	0.1	1½	0.3	4½
Mercury benzoate	0.01	⅙	0.05	¾
" bichloride	0.02	⅓	0.06	1
" biniodide	0.02	⅓	0.08	1¼
" cyanide	0.01	⅙	0.04	⅔
" protiodide	0.05	¾	0.2	3

[* These are the doses specified for the guidance of the practitioner in the French Pharmacopeia (Codex). The recommendation is made therein that where these doses are exceeded, the physician, in writing the prescription, shall specifically draw the pharmacist's attention to the fact that the unusually large dosage is ordered on purpose and not through error. In the French table the doses of alcoholic extracts, tinctures and a few other liquid preparations are given by weight, *i.e.*, in grams. Presentation of doses thus expressed as though they applied to the corresponding preparations of the U. S. Pharmacopœia would prove misleading for several reasons, and these liquid preparations have therefore been omitted from the table. The maximum dosage of the powdered drugs is, however, retained, and from this the maximum dosage of the liquid preparations may, if desired, be calculated in terms of U. S. P. preparations on the basis of the prescribed strengths of the latter as compared to the corresponding powdered drugs. The approximate equivalents of the metric doses in the apothecaries' system have been introduced in the table.—TRANSLATOR.]

MAXIMUM DOSES OF DRUGS FOR ADULTS (*continued*).

	Maximum Single Dose		Maximum in 24 Hours	
	Grams	Grains or Minims	Grams	Grains or Minims
Morphine hydrochloride	0.02	1/8	0.08	1¼
Pelletierine sulphate, in tannic solution	0.4	6	—	—
Phenol	0.1	1½	0.3	4½
Phenyl salicylate	1	15	6	90
Phosphorus	0.001	1/65	0.002	1/32
Picrotoxin	0.002	1/32	0.006	1/10
Pilocarpine hydrochloride	0.025	3/8	0.05	¾
" nitrate	0.02	1/3	0.05	¾
Piperazin	0.75	12	3	45
Podophyllin	0.05	¾	0.2	3
Potassium chlorate	1	15	4	60
" cyanide	0.01	1/6	0.04	2/3
Powdered aconite	0.1	1½	0.3	4½
" agaric	0.5	7½	1.5	22½
" belladonna leaves	0.15	2½	0.5	7½
" cantharides	0.05	¾	0.15	2½
" conium	0.25	4	0.75	12
" digitalis	0.2	3	1	15
" ergot	1	15	4	60
" gamboge	0.25	4	0.5	7½
" hyoscyamus	0.2	3	0.6	9
" ignatia	0.1	1½	0.3	4½
" ipecacuanha	2	30	2	30
" ipecacuanha and opium (Dover's powder)	1	15	4	60
" nux vomica	0.1	1½	0.3	4½
" opium	0.2	3	0.6	9
" squill	0.25	4	1	15
" stramonium	0.25	4	1	15
Pyramidon	1	15	3	45
Quassin (crystalline)	0.004	1/16	0.012	1/5
Salicylic acid	1	15	4	60
Santonin	0.1	1½	0.3	4½
Silver nitrate	0.03	½	0.15	2½
Sodium arsenate	0.01	1/6	0.02	1/3
" cacodylate	0.2	3	0.2	3
" chlorate	1	15	6	90
" methylarsenate	0.2	3	0.2	3
Sparteine sulphate	0.05	¾	0.25	4
Strophanthin	0.0003	1/200	0.001	1/65
Strychnine	0.005	1/12	0.015	¼
" sulphate	0.006	1/10	0.018	3/11
Sulphonmethane (sulphonal)	2	30	2	30
Sulphonethylmethane (trional)	2	30	2	30
Tartar emetic	0.2	3	0.6	9
Theobromine	1	15	4	60
Thymol	0.5	7½	4	60
Zinc sulphate	1	15	1	15
" valerate	0.1	1½	0.5	7½

Hypersensitiveness or hypersusceptibility of a person to a given drug, far from contraindicating its use, actually indicates it, though in minute doses gradually increased to physiologic effect. This is one of the most dependable methods of drug therapy, provided accurate regulation of dosage is carried out. This applies not only to the chemical agents, but also to biologic products such as serums and vaccines, and to physical agencies, such as hydrotherapy.

Too much stress cannot be laid on the question of dosage. As a matter of fact, any dogmatic rule in this connection is fallacious. The maximal active and toxic dose of a drug depends upon a large number of factors—age, sex, weight, morphologic peculiarities, constitution, condition of health or disease, predispositions, etc.—which in practice are very difficult accurately to determine. One cannot too strongly recommend, therefore, the simple plan which consists in giving due recognition: (1) To the results of collective experience in the past as officially reflected in the foregoing table; (2) to the results of the individual test which consists in administering a given drug to a given subject in a dose certainly smaller than the toxic dose and then increasing it gradually, systematically, mathematically until the expected physiologic effect has been obtained. Many failures in therapy are due solely to the lack of an accurate plan of dosage.

Household Measures Commonly Used in the Administration of Drugs.

The following are approximate equivalents in this connection:

An average teaspoon contains	4 to 5 c.c.	(1 to 1¼ fluidrams).
" " dessertspoon contains ...	8 to 10 c.c.	(2 to 2½ ").
" " tablespoon contains	15 c.c.	(4 ").
" " wineglass contains	50 to 70 c.c.	(1½ to 2½ fluidounces).
" " tumbler contains	150 to 200 c.c.	(6 to 8 ").

Drop and Weight Relationships of Liquid Drugs and Preparations.*

	Weight of 20 Drops in Grams	Number of Drops in 1 Gram	Weight of 1 Fluidram in Grams	Number of Drops in 1 Fluidram
Ammonia water, stronger	0.803	25	3.24	66
Amyl nitrite	0.272	73		
Chloroform	0.335	60	5.18	250
Creosote	0.487	41	3.66	122
Croton oil	0.398	50	3.24	104
Ether	0.214	93	2.52	178
Ethyl bromide	0.288	69		
Eucalyptol	0.378	53		
Fowler's solution	0.592	34	3.56	57
Hydrochloric acid	0.942	21	4.21	70
" " diluted			3.62	60
Hydrocyanic acid, diluted (2 per cent.)	0.883	23	3.49	60
Lactic acid	0.515	39	4.27	111
Methyl salicylate	0.537	37		
Nitric acid	0.840	24	4.98	102
Oil of anise	0.478	42	3.49	119
" " peppermint	0.385	52	3.24	129
" " turpentine	0.358	56	2.94	136
Phenol, liquefied	0.521	38	3.82	111
Phosphoric acid (50 per cent.)	1.032	19		
" " diluted			3.69	59
Phosphorized oil (1 per cent.)	0.400	50		
Pyridin	0.491	41		
Sulphuric acid	0.781	26	6.54	128
" " diluted	1.014	20	3.79	60
Tincture of aconite	0.350	57	2.98	146
" " arnica	0.369	54		
" " belladonna leaves	0.351	57	3.43	137
" " cantharides	0.352	57	3.33	131
" " digitalis	0.351	57	3.43	128
" " hyoscyamus	0.350	57		
" " iodine	0.327*	61*	3.04*	148*
" " nux vomica	0.348	57	2.85	140
" " opium	0.354	56	3.43	130
" " " camphorated	0.375	53	3.36	130
" " squill	0.355	56		
" " strophanthus	0.351	57		
" " valerian	0.371	54	3.36	130

[* The figures in the last two columns of the table were not included in the French edition, but are taken from a list prepared by S. L. Talbot and given in Remington's "Practice of Pharmacy." In the column headed "Number of Drops in 1 Gram" the figures are based on the use of the standard dropper authorized by the International Protocol, designed to yield *20* drops per cubic centimeter of water. In the last column, however, the figures are on the basis of 60 drops of water as being the equivalent of 1 fluidram, *i.e.*, of an equality between 1 drop of water and 1 minim. In the case of tincture of iodine, the figures in the last two columns refer to the U. S. P. tincture; in the second and third columns, to the French tincture, which contains 10 per cent. of iodine without potassium iodide.—TRANSLATOR.]

DOSAGE IN CHILDREN.

Drug dosage varies according to the age, weight, sex, and the temperament of the individual. Dose tables can supply only the traditional average doses for the average adult. It is the clinician's task to take into account the other factors on the basis of his observations and experience. As regards age, however, a number of practical rules have been vouchsafed and may be availed of.

Gaubius's table was accepted as standard for a long time.

The adult dose being taken as 1, this table provides as follows:

Age	Fraction
Below 1 year of age	1/16 to 1/12 of the adult dose.
At 2 years	1/8 " " " "
At 3 years	1/6 " " " "
At 4 years	1/4 " " " "
At 7 years	1/3 " " " "
At 14 years	1/2 " " " "
At 20 years	2/3 " " " "
From 20 to 60 years	1

The following scheme, much more easily remembered, has been used by the author for many years:

The adult dose being taken as 1, the dose for a child equals as many times one-twentieth of that dose as the child is old plus one:

Age	Dose
One year (1 + 1)	2/20 = 1/10
Two years (2 + 1)	3/20, about 1/7
Three years (3 + 1)	4/20 = 1/5
Four years (4 + 1)	5/20 = 1/4
Six years (6 + 1)	7/20, about 1/3
Eleven years (11 + 1)	12/20 = 3/5
Fourteen years (14 + 1)	15/20 = 3/4
Nineteen years (19 + 1)	20/20 = 1

This table yields, as will be noticed, figures slightly larger than that of Gaubius, which appears somewhat over-cautious. It should be repeated once again that these are not fixed but merely approximate rules, subject in practice to direct observation of the therapeutic effects produced and of individual tolerance.

DRUG INCOMPATIBILITIES.

In everyday practice, pharmacology finds its expression in the physician's work in the writing of prescriptions. In this connection there are 2 essential factors to be taken into account, *viz.*, the **solubility** of substances ordered and, in the event of combination of several drugs, a possible **incompatibility** of the drugs prescribed.

It would seem advantageous to recall, in a comprehensive table, the solubilities of the commonly used drugs in ordinary solvents, such as water, alcohol and ether. The essential facts relating to the incompatibilities, as compiled by P. Descomps, are also hereinafter presented.

TABLE OF THE PRINCIPAL DRUG INCOMPATIBILITIES.

Drug.	Incompatible with:
Acacia.	Lead acetate and subacetate, salts of iron (*precipitate*); alcoholic fluids (*precipitate*).
Ammonium acetate and chloride.	Acids and alkalies (*decomposition*).
Antimony, white oxide of (potassium antimonate).	Acids, acid salts, chlorides, cream of tartar (*formation of toxic soluble compounds*).
Antimony and potassium tartrate (tartar emetic).	Acids, acid salts, alkalies, alkali sulphates (*decomposition*). Tannic acid, astringent and albuminous fluids (*precipitate*).
Antipyrin.	Calomel, mercury bichloride, iodide solutions, dilute hydrocyanic acid, sodium salicylate, ferrous salts, chloral hydrate, salts of caffeine, liquids containing tannin, betanaphthol, tincture of iodine (*formation of liquid or colored mixtures, or precipitation*).
Arsenic trioxide and sodium arsenate.	Lime water, salts of magnesium and of iron (*precipitation of insoluble arsenites*).
Benzoate of sodium.	Acids, acid salts (*decomposition*); caffeine, in cachets (*deliquescence*).
Bismuth subnitrate.	Soluble sulphides, sulphur (*formation of insoluble bismuth sulphide*).
Bismuth subsalicylate.	Carbonates, in cachets. (*Such cachets, when immersed in water, explode, with scattering of their contents by the carbon dioxide set free through the reaction of the free salicylic acid with the calcium carbonate or sodium bicarbonate.*)
Bromides, alkaline.	Acids, acid salts, chlorine, iodine, hypochlorites, salts of iron, mercury, silver and lead (*decomposition*).
Caffeine.	Sodium benzoate and sodium salicylate, in cachets (*deliquescence*).
Carbonates and Bicarbonates.	Acids, acid salts, salts of calcium, iron, mercury and silver, alum, acid galenic preparations (extracts, wines, etc.), preparations containing alkaloids (*decomposition*).
Calcium bromide, chloride, etc.	Boric, carbonic, phosphoric, sulphuric, citric and tartaric acids and their soluble salts (*precipitation*).
Calomel.	Acids, alkalies, bromides, chlorides, iodides and cyanides, cherry-laurel water (*decomposition, formation of mercury bichloride*).
Camphor.	Resins and gum resins; musk, phenols, chloral hydrate, menthol, salicylic acid and salicylates, exalgin, resorcinol, urethane (*liquefaction*).
Charcoal, vegetable.	Potassium nitrate, sulphur, potassium chlorate (*explosive mixture*); alkaloids (*strongly absorbed by it*).
Chloral hydrate.	Alkalies (*liberation of chloroform and formate*); antipyrin, menthol, salol, thymol, acetphenetidin, camphor, in cachets (*deliquescent mixture*); antipyrin in solution (*precipitate of hypnal*).

TABLE OF THE PRINCIPAL DRUG INCOMPATIBILITIES (*continued*).

Drug.	Incompatible with:
Chlorides, soluble.	Salts of mercury, lead and silver (*precipitate*).
Chlorates of potassium and sodium.	Vegetable charcoal, vegetable powders, cream of tartar, magnesia, sulphur, salicylic acid, sodium salicylate, phenol, salol, thymol, calcium hypophosphite, nitrates, lactate of iron, potassium oxalate (*explosive mixtures*); potassium iodide (*formation of iodate*).
Cocaine hydrochloride.	Alkalies, alkali carbonates and bicarbonates, sodium borate, tannic acid, mercury bichloride, gold chloride, picric acid, metallic iodides (*precipitation*); potassium permanganate (*decomposition*).
Digitalin.	Charcoal, salts of iron, fluids containing tannic acid (*precipitation*).
Glycerin.	Potassium permanganate, chromic acid (*explosive mixtures*); ether (*non-miscible*).
Guaiacol.	Alkaline compounds (*decomposition*), camphor (*liquefaction*), ferric chloride (*colored solution*).
Hexamethylenamin.	Acids, heat.
Hydrochloric acid.	Alkalies (*chlorides*) and their carbonates (*decomposition*); salts of silver and lead, mercurous salts (*formation of insoluble chlorides*).
Hypophosphites of calcium and sodium.	Acids, metallic salts (*decomposition*); potassium chlorate (*explosive mixture*).
Iodine.	Alkalies, alkali carbonates, salts of silver, mercury and lead, cyanides. cherry-laurel water, alkaloids, acacia, starch (*decomposition or precipitation*); oil of turpentine, oil of thyme (*deflagration*).
Iodides.	Silver nitrate, lead salts (*formation of insoluble iodide*); acids, acid salts, chlorine, bromine, rancid fats (*liberation of iodine*); calomel, mercury bichloride (*formation of biniodide and of chloro-iodide*); mercurial ointment (*formation of irritating mercurous and mercuric iodides*); potassium chlorate (*formation of potassium iodate*); potassium permanganate.
Iron salts.	Alkalies, alkali carbonates, tannic acid and substances containing it (astringents, wines, cinchona), mucilaginous liquids, albumin, phosphoric acid, sodium arsenate (*insoluble precipitates*); antipyrin, phenol (*colored mixtures*); potassium chlorate (*explosive mixture*).
Iron, perchloride of (ferric chloride).	Same as above, plus salts of lead and silver, cyanides and cherry-laurel water (*Prussian blue*); adrenalin (*green color*).
Laudanum.	Alkali iodides, tincture of iodine, soluble metallic salts (*precipitation*).
Lead, soluble salts of.	Sulphuric, hydrochloric and phosphoric acids and their soluble salts (*precipitates of lead salts*); alkali iodides, tannic acid, sulphates, chlorides, arsenates, acacia, albumin and alkaloids (*precipitation*).

TABLE OF THE PRINCIPAL DRUG INCOMPATIBILITIES (*continued*).

Drug.	Incompatible with:
Magnesia and magnesium salts.	Alkalies, alkali carbonates, soluble phosphates, arsenic trioxide, sodium arsenate, sodium borate (*insoluble precipitates*); potassium chlorate (*explosive mixture*).
Mercury salts.	Alkalies, alkali carbonates, chlorides, bromides, iodides, hydrocyanic acid and cyanides, cherry-laurel water, metallic salts, tannic acid, alkaloids (*decomposition, formation of mercury bichloride, precipitation*).
Morphine and its salts.	Alkalies, alkali carbonates, alkali iodides, tannic acid, mercury bichloride (*precipitation*); potassium permanganate (*decomposition*).
Opium.	Lead acetate (*external use*), alkalies, alkali carbonates, iodine-iodide solutions, tannic acid, iodine, chlorine, mercury bichloride (*all these substances precipitate the alkaloids*).
Permanganate of potassium.	Alkaloids, acacia, sugars, alcohol (*decomposition*); potassium chlorate (*explosion*).
Persulphates of the alkalies.	Chlorides and bromides (*liberation of chlorine and bromine*), potassium iodide (*liberation of iodine*), arsenous acid (*transformation into arsenic acid*), potassium permanganate (*liberation of oxygen*), ferrous salts, betanaphthol.
Phenol.	Alkalies, ferric chloride (*blue color*), collodion (*coagulation*), antipyrin, camphor, albuminous liquids (*liquefaction or precipitation*).
Phosphoric acid and alkali phosphates.	Alcohol, alkaline salts, salts of calcium, iron, silver and lead (*precipitation or decomposition*).
Pyramidon.	Acacia (*violet color*).
Quinine salts.	Alkalies, alkali carbonates and bicarbonates, sodium borate, tannic acid, mercury bichloride, picric acid, metallic iodides (*precipitation*), potassium permanganate (*decomposition*).
Salicylate of sodium.	Acids, acid salts, salts of iron, mercury and silver (*precipitation*), borax, antipyrin, phenols (*liquefaction*).
Silver nitrate.	Alkalies, alkali carbonates, chlorides, bromides, iodides, cyanides, phosphates, sulphates, alkali salts of organic acids, organic matter (*precipitation or decomposition*).
Tannic acid.	Salts of iron, mercury, lead and silver, tartar emetic, gelatin, albumin, antipyrin, alkaloids (*precipitation*).
Valerate of ammonium.	Alkalies, acids (*decomposition*).
Zinc sulphate.	Alkalies, alkali carbonates, salts of calcium and lead, tannic acid, albuminous fluids (*precipitation*).

SOLUBILITIES OF DRUGS (P. DESCOMPS).

One part of drug is soluble in:	Water at + 15° C.	Alcohol.	Ether.
Acetanilid	220	3.5	Soluble.
Acetphenetidin (phenacetin)	1400	—	—
Acetylsalicylic acid (aspirin)	125	Freely soluble.	Freely soluble.
Aconitine	Insoluble.	" "	" "
" nitrate	Soluble.	—	—
Ammonium iodide	1	9	—
" valerate	Soluble.	Soluble.	—
Amyl nitrite	Insoluble.	Freely soluble.	Freely soluble.
Antimony and potassium tartrate	14.5	Insoluble.	—
Antipyrin	Freely soluble.	1.5	—
" salicylate	200	Soluble.	Soluble.
Apomorphine hydrochloride	40	20	Insoluble.
Arsenic trioxide ("arsenious acid")	82	140	—
Atropine sulphate	1	3	Insoluble.
Barbital (veronal)	140	—	—
Benzoic acid	373	2.4	3.1
Bismuth subgallate	Insoluble.	Insoluble.	Insoluble.
" subnitrate	"	—	—
" subsalicylate	"	Insoluble.	—
Boric acid	30	16	—
Bromoform	250	Soluble.	Soluble.
Caffeine	75	110	—
Calcium bromide	0.7	—	—
" carbonate	Insoluble.	—	—
" chloride	0.25	Soluble.	—
" glycerophosphate	25	Insoluble.	Insoluble.
" hypophosphite	6	—	—
" phosphate (mono-)	Soluble.	Insoluble.	Insoluble.
" " (di-)	Insoluble.	—	—
" " (tri-)	"	Insoluble.	Insoluble.
" sulphide	"	—	—
Camphor	840	0.8	Freely soluble.
Castor oil	Insoluble.	Soluble.	—
Chloral hydrate	0.25	Freely soluble.	—
Chloralose	Slightly soluble.	Soluble.	—
Chloroform	111	Freely soluble.	Freely soluble.
Chromic acid	Soluble.	—	—
Citric acid	0.75	2	Soluble.
Cocaine hydrochloride	0.5	—	—
Codeine	118	Soluble.	—
Collargol	25	—	—
Copper sulphate	3	Insoluble.	—
Creosote	Slightly soluble.	Soluble.	—
Cryogenin	50	—	—
Digitalin	Insoluble.	43	—
Dionin	7	1.4	Slightly soluble.
Ethyl bromide	Insoluble.	Soluble.	Soluble.
" iodide	—	Freely soluble.	Freely soluble.
Eucalyptol	Insoluble.	Soluble.	Soluble.
Exalgin	60	—	—

SOLUBILITIES OF DRUGS (*continued*).

One part of drug is soluble in:	Water at + 15° C.	Alcohol.	Ether.
Glycerin	Soluble.	—	Insoluble.
Guaiacol	52	—	—
" carbonate	Slightly soluble.	—	—
Heroin (diacetylmorphine)	Insoluble.	Slightly soluble.	—
Hexamethylenamin	Freely soluble.	Soluble.	Insoluble.
Iodine	7000	12	20
Iodoform	Insoluble.	80	6
Iron arsenate	"	—	—
" chloride (ferric)	Soluble.	Soluble.	Soluble.
" " (ferrous)	0.72	"	—
" iodide "	Soluble.	—	—
" lactate	48	Insoluble.	Insoluble.
" oxalate	Insoluble.	—	—
" reduced	"	—	—
" sesquioxide	"	—	—
" sulphate (ferrous)	1.8	—	—
Lactic acid	Soluble.	Soluble.	Soluble.
Lactose	6	Insoluble.	Insoluble.
Lead acetate	1.6	8	—
" iodide	1300	Insoluble.	—
Lecithin	Insoluble.	—	Soluble.
Lithium benzoate	3.5	10	—
" carbonate	83	Slightly soluble.	—
" salicylate	Soluble.	Soluble.	Soluble.
Lycetol	Freely soluble.	—	—
Magnesium carbonate	Insoluble.	—	—
" citrate	Soluble.	—	—
" oxide	Insoluble.	—	—
" sulphate	1	Insoluble.	—
Manganese carbonate	Almost insoluble.	—	—
" dioxide	Insoluble.	—	—
" sulphate	0.79	—	—
Menthol	Insoluble.	Freely soluble.	Freely soluble.
Mercury	—	—	—
" benzoate	Slightly soluble.	Insoluble.	Insoluble.
" bichloride	16.2	3.6	41
" biniodide	Insoluble.	130	—
" nitrate	Soluble.	—	—
" oxide	Insoluble.	—	—
" oxycyanide	100	110	—
" protochloride (calomel)	Insoluble.	—	—
" protiodide	—	Insoluble.	Insoluble.
" sulphate (basic)	Insoluble.	—	—
Methyl salicylate	Slightly soluble.	Soluble.	Soluble.
Methylene blue	0.20	Slightly soluble.	"
Monobromated camphor	Insoluble.	8.25	Freely soluble.
Morphine hydrochloride	24	50	—
Naphthol	1000	1	1

SOLUBILITIES OF DRUGS (*continued*).

One part of drug is soluble in:	Water at + 15° C.	Alcohol.	Ether.
Naphthyl benzoate	Insoluble.	257	—
" salicylate	"	140	Soluble.
Nitroglycerin	Slightly soluble.	—	—
Pancreatin	Incompletely soluble.	Insoluble.	—
Paraformaldehyde (trioxymethylene)	Insoluble.	"	Insoluble.
Pelletierine sulphate	Soluble.	—	—
Pepsin	"	—	—
Peptone	"	—	—
Petrolatum	Insoluble.	Insoluble.	1
" liquid	"	Very slightly soluble.	Soluble.
Phenol	19.6	Soluble.	"
Phenolphthalein	1000	4	—
Phenyl salicylate (salol)	Insoluble.	10	0.3
Phosphoric acid	Soluble.	—	—
Phosphorus	Insoluble.	Very slightly soluble.	Soluble.
Picric acid	81	—	5.7
Pilocarpine hydrochloride	Freely soluble.	Freely soluble.	Insoluble.
" nitrate	8	Very slightly soluble.	—
Piperazin	Freely soluble.	Soluble.	Insoluble.
Potassium acetate	0.5	3	—
" bitartrate	210	Insoluble.	—
" bromide	1.6	200	—
" chlorate	15.8	—	—
" iodide	0.7	12	—
" nitrate	4	3	Insoluble.
" permanganate	16	—	—
" sulphide	2	—	—
Protargol	2	—	—
Pyramidon	10	Soluble.	—
" salicylate	7	—	—
Pyridin	Miscible.	Miscible.	Miscible.
Quinine bisulphate	109	32	—
" dihydrobromide	6.55	Freely soluble.	Insoluble.
" dihydrochloride	0.67	" "	—
" glycerophosphate	300	Soluble.	—
" hydrobromide	44.5	"	Soluble.
" hydrochloride	25	3	—
" sulphate	570	80	—
Resin of jalap	Insoluble.	Soluble.	—
" " podophyllum	—	10	—
" " scammony	—	Soluble.	Soluble.
Resorcinol	Freely soluble.	Freely soluble.	Freely soluble.
Saccharin	400	30	100
Salicylic acid	500	3	2
Salophen	Insoluble.	Soluble.	Soluble.
Santonin	"	"	—
Silver nitrate	0.4	10	—
Sodium arsenate	1.64	Insoluble.	—
" benzoate	2	24	—

SOLUBILITIES OF DRUGS (*continued*).

One part of drug is soluble in:	Water at + 15° C.	Alcohol.	Ether.
Sodium bicarbonate	12	Insoluble.	—
" borate	22	"	—
" bromide	1.15	16	—
" cacodylate	Freely soluble.	Freely soluble.	—
" chloride	2.8	Very slightly soluble.	—
" citrate	Freely soluble.	Slightly soluble.	—
" glycerophosphate	" "	—	—
" hypophosphite	2	30	—
" iodide	0.6	3	—
" methylarsenate	Freely soluble.	Slightly soluble.	Soluble.
" nitrite	Soluble.	—	—
" phosphate	6.7	—	—
" salicylate	1	5	11
" sulphate	2.78	—	—
" sulphide	Freely soluble.	—	—
" thiosulphate	1	Insoluble.	—
Sparteine sulphate	Freely soluble.	—	—
Stovaine	" "	Soluble.	—
Strontium bromide	1	1.6	—
" iodide	0.5	—	—
" lactate	3	Insoluble.	—
Strophanthin	40	—	Insoluble.
Strychnine sulphate	36.5	Insoluble.	"
Sulphonmethane (sulphonal)	500	65	80
Sulphonethylmethane (trional)	320	14	12
Sulphur	Insoluble.	—	—
Sulphurated antimony (kermes mineral)	"	—	—
Sulphuric acid	Soluble.	Soluble.	—
Tannic acid	1	2	80
Tartar emetic	14.5	Insoluble.	—
Tartaric acid	0.8	2	Insoluble.
Terpin hydrate	250	16.9	100
Theobromine	1600	Insoluble.	Insoluble.
" sodio-salicylate	Soluble.	Slightly soluble.	Slightly soluble.
Thymol	1200	Soluble.	Soluble.
Urethane (ethyl carbamate)	1	0.6	—
Valeric (valerianic) acid	30	Miscible.	Miscible.
Vanillin	100	Freely soluble.	Freely soluble.
Zinc chloride	0.3	—	Soluble.
" oxide	Insoluble.	—	—
" phosphide	"	—	—
" sulphate	0.66	Insoluble.	—
" valerate	50	35	—

DRUGS ACTING SPECIFICALLY ON A DEFINITE ORGANIC FUNCTION.

I

DRUGS ACTING ON THE CIRCULATORY SYSTEM.

An accurate **pharmacodynamic classification** of the drugs acting selectively on the circulatory functions and blood is not now practicable. It will be sufficient to divide them roughly, according to their clinical applications, into:

Cardiac remedies, acting selectively on the cardiac functions.

Vascular remedies, acting selectively on the vessels.

Diuretics, acting selectively on the renal functions.

Hematinics, acting selectively on the blood.

This classification is an artificial one. The cardiac, vascular and diuretic drugs are nearly all, in varying degrees, according to the case and the doses used, both cardiovascular and diuretic in action, the cardiovascular and renal functions being synergistic. The classification is incomplete, many available agents being omitted from it: It is necessary to select and keep within bounds. Such as it is, it will enable us to encompass in it and describe the commoner drugs which will have to be taken into account in the treatment of circulatory symptoms and disorders, and to establish a simple grouping which will constitute a useful preliminary approximation previous to the study of the methods of drug treatment. Furthermore, these drug groupings will be gone over, discussed and completed during the presentation of these methods of treatment. Thus, the reader will find described here as hematinics only arsenic and iron, the hematopoietic serums being taken up under serum therapy, the ductless glands under organotherapy, etc. This practically unavoidable didactic deficiency will necessarily be found compensated, however, on referring to the treatment of the anemias, in which a comprehensive discussion of blood regeneration is presented. A pharmacologic presentation such as is intended in this earlier portion of the work does not lend itself to a synthetic grouping of the drugs.

A.—DRUGS ACTING ON THE HEART.

DIGITALIS AND ITS SUBSTITUTES.

WHEN AND WHY SHOULD DIGITALIS BE GIVEN?

For practical purposes the indications for and contraindications to digitalis can be grouped analytically under the following four headings:

I.—*Action on the heart-rate.*

II.—*Action on the blood-pressure.*

III.—*Action on the vessels and on diuresis.*

IV.—*Choice of a digitalis preparation.*

Indications and Contraindications Derived from the Action of Digitalis on the Heart-rate.

I.—**Action on the Heart-rate.**—Digitalis slows the rate of the heart. This slowing is due to a depressant action on and lessening of conductivity, both of nervous, extracardiac (vagus) and of myocardial, intracardiac (bundle of His) origin. This is a physiopathologic feature of prime importance, and one which dominates the indications of digitalis in the cardiac arhythmias.

Clinically, this action is as follows:

(1) Practically specific in the tachy-arhythmias (complete arhythmia, auricular fibrillation).

(2) Of slight utility in paroxysmal, nervous or febrile tachycardia.

(3) In general, contraindicated in bradycardia and premature contractions.

(4) Absolutely contraindicated where there is a tendency to heart-block or an actual partial heart-block.

II.—**Action on the Blood-pressure.**—*When administered to a patient with cardiac insufficiency digitalis sometimes raises, sometimes lowers, and sometimes produces no effect on the systolic pressure.* **It always lowers the diastolic pressure.** It usually increases the differential or pulse pressure (difference between systolic and diastolic pressures). It slows the pulse rate and increases the urinary output.

III.—**Action on Diuresis.**—The diuretic action of digitalis is dependent upon a *central heart-tonic action* resulting in an increase of the pulse pressure and a *peripheral renal vasodilator action* of which lowering of the diastolic blood-pressure is, among other evidences, a good indication.

Digitalis is thus at once a *direct diuretic through heart-tonic action* and an *indirect diuretic through renal vasodilator action.*

Digitalis diuresis is relatively slow in appearing. It begins, on an average, 24 to 36 hours after administration of the drug, and generally continues for several days. It is thus tardy, of fair amount, and prolonged.

The subjoined diagram condenses and summarizes the aggregate of these characteristic and valuable actions of digitalis.

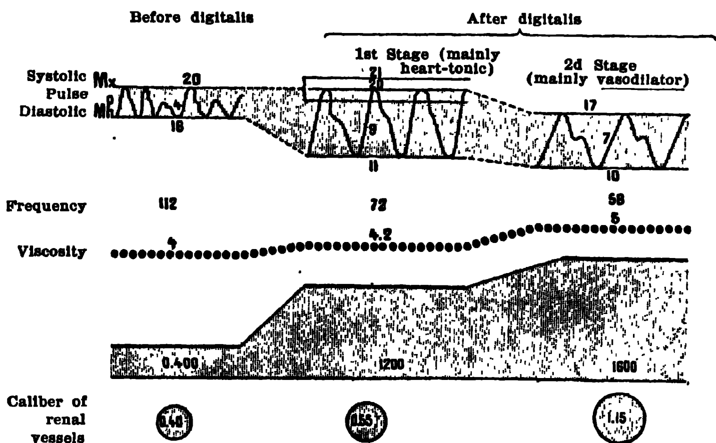


Fig. 1.—Diagram illustrating the effects of digitalis on the systolic and diastolic blood-pressure, the pulse frequency, the viscosity of the blood, diuresis and the caliber of the renal vessels in a case of heart failure. (Blood-pressure notations in *centimeters* of mercury; urine output in cubic centimeters.)

These observations lead to the use of digitalis at times to lower blood-pressure.

(1) In *heart failure with high blood-pressure.*

(2) In *some cases of high blood-pressure dependent upon cardio-renal sclerosis,* in which administration of digitalis in minute doses, such as 0.0001 to 0.00025 gram ($\frac{1}{650}$ to $\frac{1}{260}$ grain) of digitalin (French), in intermittent periods of 4 to 10 days or twice a week, frequently brings about, along with improved diuresis, a more or less pronounced reduction of the systolic in conjunction with a less marked reduction of the diastolic pressure.

(3) In some cases of *angina pectoris.*

IV.—**General Clinical Indications.**—If, bearing in mind the fact that present-day nosology is still largely pathologic and lesional, we try to adapt the foregoing new or remodelled facts to the hitherto

recognized entities, the *general indications for digitalis* may be summarized thus:

In **aortic insufficiency**, of whatever type or origin:

(1) In the stage of compensation, digitalis proves of slight service, or only in small, long-continued (vasodilator) doses.

(2) In the stage of decompensation, of mitral involvement, of definite heart weakness or failure, the general digitalis indication for strengthening the heart-action, in full dosage, holds good.

In **mitral disorders** (insufficiency, mitral disease, mitro-aortic disease in the period of decompensation), and in a general way in the stage of mitral disturbance in all heart disorders, properly applied digitalis therapy gives the most prompt, complete, and striking results. At present, as of yore, digitalis stands out as the physiopathologic specific for heart failure.

In **mitral stenosis**, distinctions between cases are necessary. If the stenosis is relatively slight, and if there is no tendency to heart-block, digitalis may yield favorable results. If the stenosis is a tight one, or if there is a tendency to block, digitalis is contraindicated.

In **chronic myocarditis**, continuous digitalization in small dosage, corresponding to 0.0001 to 0.0002 gram (1/650 to 1/325 grain) of (French) digitalin [=0.1 to 0.2 gram (1½ to 3 grains) of digitalis leaf] *per diem*, for periods of 10 to 20 days with intervening pauses of 5 to 10 days, frequently proves of the greatest service.

In **pericarditis**, digitalis is indicated only to the extent that the subjacent myocardium is involved.

In **chronic nephritis** and **arteriosclerosis**, administration of digitalis may be appropriate in two distinct periods:

(1) In the final stage of cardiac decompensation, of mitral disturbance, during which the indication for digitalis is the general indication relating to heart failure or weakness.

(2) In the stage of satisfactory compensation and cardiac hypertrophy, during which the indication is arterial and renal rather than cardiac. In this period, one may resort to the practice of intermittent digitalization in small doses, alternating with periods of administration of diuretic substances of the type of caffeine or theobromine.

Thus, one might prescribe:

(*a*) Digitalin (French), 0.0001 gram (1/650 grain) [or digitalis leaf, 0.1 gram (1½ grains)], on the first 2 or 3 days of the week.

(*b*) Theobromine, 1 gram (15 grains) a day, on the next 2 or 3 days.

(*c*) No drug treatment on the last 2 or 3 days of the week.

Digitalis and caffeine medication may be similarly combined or alternated, thus instituting an actual caffeine-digitalin therapy which is particularly effective in certain cases.

As for the **failing heart:**

From the foregoing facts it will be noted that *digitalis is almost a specific for definite heart weakness or heart failure.* It is indicated in all diseases of the heart or vessels during the period in which these conditions obtain. As a matter of fact, it is much more frequently indicated in mitral than in aortic cases.

Again, for digitalis to be really effective, the three following conditions must be completely fulfilled:

(1) The drug must have been *correctly* given, *i.e.,* in the serviceable doses to be mentioned later; *absolute rest must have been instituted,* the *intake of fluids reduced,* and, according to the case, the *impediments to circulation in the viscera and at the periphery overcome,* as by puncture, cupping, drainage, etc. (see Part III: *Diseases of the Circulatory System*).

(2) Dilatation of the heart must not be excessive; the *myocardium must have retained a certain amount of reserve power* enabling it to respond to the digitalis stimulation.

(3) There must be no heart-block.

In **various extra-cardiac disorders:**

Next to the heart disturbances, *pulmonary disorders* afford the most frequent indications: *Emphysema with chronic bronchitis, primary or secondary congestion of the lungs,* and especially the *pneumonias.*

In *renal disorders,* the drug is particularly indicated in the terminal stage of decompensation in *Bright's disease.*

Finally, in all cases in which it is necessary to stimulate the circulation, tone up the myocardium, or facilitate absorption of exudates or the elimination of toxins; one may thus be led to use digitalis in *pleurisy, rheumatism,* the *eruptive fevers, influenza, tuberculosis, etc.*

* * *

In all these cases one should be guided, in the *administration of digitalis, by the following precepts:*

(1) The digitalis given should be "neither too much, nor too little, nor too often, nor too long."

(2) All other medication should be stopped during its administration.

(3) According to indications, the patient should be kept either in bed, in his room, or relatively at rest.

(4) One should seek to reduce the vascular repletion and peripheral obstructions by appropriate means, such as leeching, purgation, punctures, scarifications, reduction of fluids, etc.

Digitalis Intoxication.—The effects previously mentioned are produced by therapeutic amounts of digitalis, such as 0.5 to 1 gram (7½ to 15 grains) of the powdered leaves or 0.001 gram (1/65 grain) of digitalin (French), administered in accordance with the recognized precepts: Neither too often, nor too long.

Larger doses, or doses too long continued or too frequently repeated, induce *toxic manifestations:*

(1) Some of these are mainly the clinical expression of *paralysis of the inhibitory nerves (vagi) and of predominant excitation of the sympathetic and vasoconstrictors:* Tachycardia, arhythmia, bigeminal pulse, pallor of the face, hypothermia, tendency to chilliness, dizziness, headache, mydriasis, hallucinations, delirium, etc.

(2) The others are brought about by the *direct action of digitalis on the mucous membranes:* Gastrointestinal manifestations, such as an unpleasant bitter taste, dryness of the throat, vomiting, cramps, diarrhea, etc. [Direct stimulation of the emetic center also occurs.]

Both of these varieties of untoward results indicate suspension of the use of the drug.

HOW SHOULD DIGITALIS BE GIVEN?

Digitalis consists of the leaves of *Digitalis purpurea,* of the natural order Scrophulariaceæ, a biennial herbaceous plant to which its generic name was applied because of the glove-finger-like shape of its flower.

(*a*) The *galenic preparations* include all the preparations of the pharmacopeias of old: Powder, infusion, maceration, tinctures, and various extracts. The only objection to them is the variability of their action according to the content of active principles in the digitalis leaf. Perrot and Goris have succeeded, however, in stabilizing the fresh plant by sterilization (destruction of ferments) and desiccation.

(*b*) *Digitalin (French),* the "digitaline cristallisée" of the Codex, constitutes a standard, crystalline principle of perfectly definite chemical composition, always the same, permitting of mathematically accurate dosage through the use in practice of granules of 0.0001 and 0.00025 gram (1/650 and 1/260 grain), and a 1:1000 solution of which 50 drops from the standard dropper equal 1 c.c. (16.2 minims) and 0.001 gram (1/65 grain) of the glucosid. [This French official digitalin is regarded as essentially a form of *digitoxin,* which is the most powerful

of the digitalis principles and is obtainable in American shops for similar use in like dosage.—Tr.]

(*c*) *The most certain in action of the digitalis preparations,* however, *are those which contain all of its active principles and upon which careful physiologic standardization* has conferred the constancy of action of digitalin (French).

(*d*) *Digifolin,* said to combine digitalin and digitalein in the natural combination existing in the leaf, is a preparation of some interest.

* * *

As regards the *dosage,* we may accept the practical grouping of Huchard:

Massive Dose, for Heart Failure, Diuretic: Digitalin (French), 0.001 Gm. (1/65 grain) in 1 day (or divided between 2 or 3 days) = 1 gram (15 grains) of powdered leaf = 6 c.c. (96 minims) of digalen = 5 c.c. (80 minims) of digifolin (or five 0.1-gram tablets). It should be remembered that digitalis is eliminated slowly and accumulates in the system, and intervals of at least 5 days between the above doses should be allowed.

Intermediate Dose, Cardio-tonic as Well as "Cardio-sedative:" Digitalin (French), 0.00025 gram (1/260 grain) = 0.25 gram (3¾ grains) of powdered leaf = 50 *drops* of digalen = 2 c.c. (32 minims) of digifolin or two 0.1-gram (1½-grain) tablets.

This is the dosage which is suitable in the period of restoration of cardiac compensation, in the dyspnea of mitral stenosis, and in periods of partial heart-failure. It should be given for periods of 3 or 4 days in succession, followed by intermissions of at least equal duration.

Very Small Dose: Digitalin (French), 0.00005 to 0.0001 gram (1/1300 to 1/650 grain) = 0.05 to 0.1 gram (¾ to ½ grains) of powdered leaf = 10 to 20 drops of digalen = 0.5 to 1 c.c. (8 to 16 minims) of digifolin or one 0.1-gram (1½-grain) tablet, continued for a period of 10 to 20 days in each month.

This last plan is indicated:

(1) As a systematic treatment of angina pectoris.

(2) As a systematic treatment of angiospastic and organic high blood-pressure.

(3) In periods of decompensation in aortic arterial insufficiency.

(4) In combined valvular lesion and chronic lung disorder.

[Following are procedures recognized of late in America:

SMALL DOSE METHOD: Digitalis leaf, 1 to 4 grains (0.06 to 0.25 gram), or its equivalent in other preparations, four times daily until digitalization results (four to six days).

LARGE DOSE METHOD: First day: 6 to 7 grains (0.4 to 0.5 gram) every six hours for four doses. Second and subsequent days: 3 grains (0.2 gram) every four hours (except at night) until digitalization results.

EGGLESTON METHOD: Based on the body-weight and cat unit strength of the preparation used. For full strength digitalis leaf, the total dose is 1.5 *grams* (22½ grains) per 100 pounds of body weight. Of this amount, about ½ is given as the first dose, about ¼ six hours later, next about ⅙, and then about 1/10 until digitalization results. Allowances are made for the weight of edema fluid, and precautionary reductions for digitalis of unknown cat unit strength (only ¾ of the total amount being given in the first three doses) and for digitalization during the previous ten days.]

MODES OF ADMINISTRATION.

Maceration of 0.25 to 1 gram (3¾ to 15 grains) of powdered leaf in cold water for 12 hours. Filter and flavor with a syrup, such as syrup of orange or syrup of orange flowers, *e.g.:*

℞ Digitalis pulveris .... 0.8 gram (gr. xij);
Aquæ .... 160 c.c. (f℥vss);
Macera sec. art. et adde:
Syrupi aurantii .... 40 c.c. (f℥x).
Sig.: To be taken in 2 doses (in *failing heart*).

Infusion of 0.25 to 1 gram of powdered leaf for ½ hour. Filter and flavor as above. [*Infusum digitalis,* U. S. P., 1.5 per cent.; average dose, 6 c.c. (1½ fluidrams).]

Pills may be made with fresh powdered leaf each containing 0.05 Gm. (¾ grain).

Tincture [*Tinctura digitalis,* U. S. P., 10 per cent.; average dose, 1 c.c. (15 minims)].

Fluidextract [*Fluidextractum digitalis,* U. S. P. IX, 100 per cent.; average dose, 0.06 c.c. (1 minim)].

For practical purposes, 0.2 gram (3 grains) of leaf = 50 drops [or 30 minims] of tincture. One gram (15 grains) of leaf = 0.001 gram (1/65 grain) of digitalin (French).

COMBINATIONS WITH DIGITALIS.

(1) *Diuretic and purgative.*

(a) *Heart-tonic, diuretic and purgative pills:*

℞ Digitalis pulveris,
Scillæ pulveris,
Resinæ ipomœæ ....āā 0.05 gram (gr. ¾).
Ft. pil. No. i. Da tal. No. xx.
Sig.: Eight pills the first day, seven the second, and five the third, to be taken at regular intervals between meals. (For *failing heart* and *uremia*).

(b) *Trousseau's diuretic wine:*

℞ Digitalis .... 5 grams (gr. lxxv);
Scillæ .... 7.5 grams (gr. cxij);
Juniperi .... 75 grams (℥iiss);
Vini albi .... 900 c.c. (f℥xxx);
Alcoholis .... 120 c.c. (f℥iv);
Macera sec. art. et adde:
Potassii acetatis .... 50 grams (ʒxiij).
Sig.: Three tablespoonful doses daily.
(The maceration should be continued for two weeks.)

(2) *Miscellaneous combinations:*

(a) *For heart disease with marked hepatic congestion:*

℞ Digitalis pulveris,
Scillæ pulveris,
Hydrargyri chloridi mitis ....āā 0.05 gram (gr. ¾);
Extracti ergotæ aquosi, N. F. .... 0.1 gram (gr. iss).
Ft. pil. No. i. Da tal. No. xv.
Sig.: Five pills a day for 3 days. Watch gums carefully for mercurial stomatitis.

(b) *For various forms of hemorrhage, including hemoptysis:*

℞ Extracti opii,
Digitalis pulveris, ...āā 0.01 gram (gr. ⅙);
Extracti ergotæ aquosi,
Quininæ sulphatis ....āā 0.1 gram (gr. iss).
Ft. pil. No. i. Da tal. No. xx.
Sig.: One every half-hour until the hemoptysis terminates.

Digitalis Injections.—These have as yet been availed of but little in current practice, yet can readily be carried out with the standardized whole extracts of the drug, such as digalen and digifolin, which are well tolerated by and absorbed from the tissues.

Such injections have been considered indicated in urgent cases where the action of the drug must be secured within a few hours. For this purpose the hypodermic route may be employed, the action of the digitalis then becoming manifest at most one or two hours after the injection. The same applies in the case of digestive disturbances.

In extreme emergency cases, *e.g.*, those of heart failure in its final stage or with coma or thready pulse, etc., intravenous injection has been held justifiable.

In the case of *digalen,* 1 ampule for hypodermic or intravenous injection corresponds to 0.15 gram (2¼ grains) of powdered digitalis leaves or to 0.00015 gram (1/400 grain) of digitalin (French).

One or two ampules given intramuscularly constitute a small or "sedative" dose; 3 to 6 ampules, similarly given, constitute a large dose, suitable for use in heart-failure.

In the case of *digifolin,* one 1-c.c. (16-minim) ampule, or a 0.1-gram (1½-grain) tablet corresponds to 0.1 gram (1½ grains) of the leaves, or 0.0002 gram (1/325 grain) of digitalin (French).

One or two ampules, given intramuscularly or intravenously, constitute an average or "sedative" dose; 3 to 5 ampules, similarly given, constitute a large dose, for use in heart-failure.

The solution of *digitalin* (*French*) in alcohol and glycerin, official in the French Codex, may be perfectly suitable for intravenous injections when diluted with distilled water or saline solution. The dose is from 0.1 to 0.5 c.c. (1½ to 8 minims), or 5 to 25 drops, which may if necessary be repeated 2 or 3 times in twenty-four hours.

DIGITALIS SUBSTITUTES.

STROPHANTHUS.—This is the drug which is most closely allied to digitalis among the heart-tonics. It consists of the seeds of *Strophanthus kombé* or *hispidus* (Apocynaceæ). It is a powerful *heart-tonic,* the *diuretic* action of which has long been a subject of controversy. Different from digitalis, it has been thought to act partly as a direct diuretic, influencing the renal epithelium. [This is very doubtful.—Tr.]

It is a highly toxic substance, the type of the poisons of the heart-muscle, and its use requires more care than does that of digitalis.

For practical purposes:

1. Strophanthus is a drug to be resorted to mainly where digitalis fails or is not well borne, particularly in certain forms of arhythmia pointing to disturbances of cardiac conductivity.

2. The most reliable mode of administration seems to be that of regularly progressive doses under careful observation.

3. The pronounced variation in the active principles in the crude product makes it advisable to adopt a stable preparation of practically constant composition, and possessed of carefully tested [standardized] physiologic activity.

MODES OF ADMINISTRATION.

Tincture [*Tinctura strophanthi,* U. S. P., 10 per cent.; average dose, 0.5 c.c. (8 minims)].

Powdered seeds [*Strophanthus*, U. S. P., average dose, 0.06 gram (1 grain)].

Strophanthin [*Strophanthinum*, U. S. P.]. In very serious, refractory cases of heart weakness in which digitalis has failed, the use of *intravenous injections* of a *1:1000 solution of strophanthin* has been recommended. The single dose is 0.25 to 0.5 c.c. (4 to 8 minims), *i.e.*, 0.00025 to 0.0005 gram (1/260 to 1/130 grain) of strophanthin, to be repeated according to indications.

The conclusions reached by Danielopolu in regard to strophanthin medication should be kept in mind:

1. Strophanthin (and ouabain) *exert the same action as digitalis.* There exists between these two drugs only a difference as to rapidity of action, which is in favor of strophanthin (when the drug is administered intravenously), and a difference as to duration of action in favor of digitalis.

2. The method of fractional intravenous doses (3 intravenous injections a day, of 0.25 milligram each) is far preferable to the use of larger doses (0.5 milligram) in that it yields equally good results *without entailing a risk of sudden death.*

OUABAIN.—Some observers (Blondel, d'Arnaud, Vaquez, and Lutembacher) recommend more particularly the use of *ouabain*, or *gratus strophanthin*, extracted from *Strophanthus gratus*, in doses of 0.00025 to 0.0005 gram (1/260 to 1/130 grain).

Following such treatment, whether from an unfortunate choice of desperate cases or mere coincidence, rather many cases of death following the intravenous injection have been recorded (Lutembacher, Vaquez and Leconte, Richaud, and others).

According to the clinicians who have tested it out the most extensively and systematically, ouabain should remain an emergency remedy, to be reserved for acute heart-failure, in which, however, it is stated sometimes to yield "surprising" results, though at the price of some actual risk.

Injected intravenously, however, ouabain is more easily managed than strophanthin.

Since it has been given by the mouth the use of ouabain has extended more rapidly in medical practice.

According to Vaquez and Lutembacher, ouabain acts on cardiac contractility and tonicity, and has only a slight action on the frequency of the contractions, being contrary in this respect to digitalis.

The indications for ouabain are: Acute insufficiency of the left ventricle with angina pectoris or with acute edema of the lung; insufficiency of the right heart which does not yield to digitalis. It is the

emergency remedy, while digitalis is stated to be the remedy for ordinary cases. Sometimes, after the administration of ouabain, digitalis recovers its activity.

The contraindications to the use of ouabain are stated to be: Advanced heart cachexia with general serous infiltration; inflammatory complications in the lung; hepatic insufficiency; severe organic lesions of the kidneys; infectious endocarditis, and the recent use of digitalis.

MODES OF ADMINISTRATION.—The solution of ouabain of Arnaud, 1:1000, is clinically used. Fifty drops = 0.001 gram (1/65 grain) of ouabain. Or, tablets of ouabain, 0.0001 gram (1/650 grain), may be employed.

In acute insufficiency of the left ventricle with acute cardiac distension, manifested by an attack of angina pectoris, of decubitus, or of pulmonary edema, 50 to 100 drops of the solution daily should be given.

In progressive insufficiency of the left heart, manifested by tachycardia, extra-systolic arrhythmia, and gallop rhythm with or without an attack of hypertension, 25 to 50 drops daily, or 5 to 8 tablets daily, should be given for from 3 to 5 days.

The patient is prepared for the administration of ouabain by the removal of 200 to 300 c.c. of blood, by a drastic purge, rest in bed, and a milk diet.

At the onset of left ventricular insufficiency, in cases with high blood-pressure or aortic disease, 10 to 20 drops of ouabain solution, or 2 to 4 tablets per day, should be given for 5 to 6 days.

According to D. Routier it is necessary to give, to obtain results, at least 0.001 gram (1/65 grain) per day in a single dose.

As Laubry has demonstrated, digitalin can be combined with ouabain; for example, a mixture of one-third of digitalin and two-thirds of ouabain may be employed either by the mouth or by intravenous injection.

The same doses should be given as in the case of ouabain alone, the total dose of digitalin administered being taken into account if the treatment is prolonged a few days.

SPARTEINE.—This is an alkaloid obtained from broom flowers (*Cytisus scoparius* or *Spartium scoparium*, of the family Leguminosæ, subgroup Papilionaceæ). It was introduced into therapeutics by Laborde and Germain Sée in 1885, and is a pure heart "sedative" exerting little or no action on the vessels and blood-pressure and eliminated through the kidneys without irritation of these organs. In small dosage it has no appreciable action on the heart-muscle. [The slowing of the pulse-rate is

not prevented by atropine, and has therefore been ascribed to depression of the heart-muscle.—Tr.]

One may expect from its administration:

1. Regularization, or more frequently a slowing, of the heart-action.

2. Alleviation of various subjective manifestations, such as dyspnea, palpitations, precordial pain, etc.

Satisfactory results from its use are therefore chiefly to be expected:

1. In functional or subjective heart disturbances (disturbed rhythm, palpitations, painful angor, anginal manifestations, etc.) dependent upon nervousness, neurasthenia, hysteria, anemia, overwork, alcoholism, tobacco abuse, etc.

2. In the functional or subjective disturbances of well-compensated heart disease, and particularly in heart disease with normal or increased blood-pressure (arteriosclerosis and cardiosclerosis).

3. In Graves's disease.

4. In asthmatic attacks in the emphysematous and in cases of chronic bronchitis.

Sparteine [*Sparteinæ sulphas,* U. S. P. IX], which is of low toxicity, may be given in average daily amounts of 0.01 gram (1/6 grain) per year of the patient's age, in children, and of 0.05 to 0.1 gram (3/4 to 1 1/2 grains) or more in adults.

Pills of sparteine containing 0.02 gram (1/3 grain) may be given to the number of 3 to 6 a day. The following pill may be used for *palpitations:*

℞ Sparteinæ sulphatis .... 0.02 gram (gr. 1/3);
Extracti valerianæ .... 0.05 gram (gr. 3/4).
Ft. pil. No. i. Da tal. No. xxx.
Sig.: Three pills a day.

Solution:

℞ Strychninæ sulphatis .... 0.05 gram (gr. 3/4);
Sparteinæ sulphatis .... 0.8 gram (gr. xij);
Syrupi aurantii .... 75 c.c. (f℥iiss);
Aquæ destillatæ .... 200 c.c. (f℥vij).
Misce. Sig.: One to two tablespoonfuls a day. (In *chronic myocarditis, pneumonia, and infectious diseases with a tendency to neurocardiac weakness.*)

It is sometimes combined with potassium iodide. There is not an absolute incompatibility, but a precipitate results after a time.

For hypodermic injection:

1. ℞ Sparteinæ sulphatis .... 0.5 gram (gr. viiss);
Aquæ destillatæ .... 10 c.c. (f℥iiss).
S. et sterilisa.
(1 to 2 c.c. a day.)

2. ℞ Morphinæ hydrochloridi .... 0.1 gram (gr. iss);
Sparteinæ sulphatis .... 0.6 gram (gr. x);
Aquæ destillatæ .... 10 c.c. (f℥iiss).
S. et sterilisa.
(1 c.c. before chloroform anesthesia.)

CONVALLARIA MAJALIS (LILY-OF-THE-VALLEY) (Liliaceæ).—An aqueous extract may be prepared by infusion and evaporation of the entire plant, recently collected while in flower and dried.

This is a *rather harmless heart tonic, unreliable as diuretic,* but sometimes very active.

It is a third-rate remedy, but one which may be serviceable during digitalis intermissions.

The bitterness of its preparations should be disguised with syrup of bitter orange peel. The maximum dose of the French official aqueous extract is 0.5 gram (8 minims) at a dose, or 3 gram (48 minims) a day.

[The American preparations are:

Convallariæ radix, N. F., 0.5 gram (8 grains).

Fluidextractum convallariæ radicis, N. F. (made with a mixture of alcohol and water), 0.5 c.c. (8 minims).]

ADONIS VERNALIS (Ranunculaceæ).—The entire plant is used. It is a diuretic heart-tonic, rapidly acting, free of cumulative action, and a possible substitute for digitalis. It may induce gastro-intestinal disturbances.

Adonis may be combined with small amounts of codeine in cases of bronchitis with a tendency to heart weakness.

[*Adonis,* N. F., 0.125 Gm. (2 grains).

Fluidextractum adonidis, N. F., 0.125 c.c. (2 minims)].

CAMPHOR IN OIL.

Camphor is a stimulant to the nerve centers and heart. Its principal indication, by the hypodermic route, is in the treatment of febrile disorders associated with nervous disturbance and general weakness and of myocardial enfeeblement and collapse. Aside from this, camphor is asserted to exert a vasodilator action on the vessels of the lesser circulation before it induces a similar action on the general systemic vessels. It acts rapidly and effectively, and is practically harmless.

Camphor has been deemed especially useful in pneumonia by reason of its antiseptic action on the pneumococcus and its vasodilator action on the pulmonary circulation.

It is used particularly in the form of *hypodermic injections of 10 per cent. camphor in oil,* in doses of 1 to 5 c.c. (16 to 80 minims), repeated if necessary 2 or 3 times in the 24 hours.

Generally there is advantage in combining it with ether, which serves not only to make the camphorated oil more fluid and to reduce its viscosity, which renders injection of it through fine needles rather troublesome, but also to enhance and accelerate its stimulating action. The following formula may be used:

℞ Ætheris .... 2 c.c. (♏xxxij);
Olei camphoræ (10 per cent.) .... 20 c.c. (f℥v).
Sig.: One to six cubic centimeters (16 to 96 minims), according to indications.

In tuberculosis Maurange recommends the following:

℞ Camphoræ .... 1 gram (gr. xv);
Guaiacolis .... 8 grams (ʒij);
Olei olivæ sterilisati .... 100 c.c. (f℥iiiss).
M. Sig.: Ten cubic centimeters (2½ drams) on alternate days.

Some authors have advocated intravenous injections of camphor in oil. Cases of embolism, and particularly of cerebral embolism, following such medication have, however, been reported and would appear definitely to contraindicate its employment. The possibility of producing "paraffinomas" and local swellings makes it necessary, moreover, to avoid the use of liquid petrolatum as a menstruum for camphor and to take care not to inject camphorated oil either in too large an amount, for too long a time, or at unduly short intervals.

THE DIFFUSIBLE STIMULANTS.

Lastly, mention will be made of a number of agents long ago designated as diffusible stimulants because, different from the foregoing remedies, the deep-seated and prolonged action of which on the circulation is always a little slow in manifesting itself, they exert a quick, though fleeting, stimulant action.

ALCOHOL.—The evanescent stimulating action of alcohol is unquestionable to any observer whose judgment is not clouded by an idealistic, passionate opposition to this drug. It is manifested objectively in acceleration of the heart, dilatation of the vessels, flushing of the face, and at times a secondary diuretic action. The same applies to the nervous functions, which are plainly excited. That, following secondarily upon this stimulant action, there may occur a depressant action affecting both the circulatory and the nervous functions, is doubtless true; this is certainly the case after prolonged, excessive

administration. It is nonetheless a fact that in moderate amounts alcohol may, in properly selected cases, exert a stimulant action on the nervous system and circulation which is particularly useful in febrile disorders with general adynamia and nervous disturbance. Thus originated Todd's mixture, long used in pneumonia.

Todd's mixture (Codex, 1908).

℞ Alcoholis diluti	40 grams	(f℥iss);
Tincturæ cinnamomi (N. F.)	5 grams	(fʒiss);
Syrupi	30 grams	(fʒvj);
Aquæ destillatæ	75 grams	(f℥iiss).

M. Sig.: To be taken in divided amounts in 24 hours.

In the case of champagne, the action of the carbonic acid gas is added to that of the alcohol.

Rectal administration may be of value in patients with intolerant stomachs. Elsewhere (*Aliments usuels,* 2d Ed., p. 327) I have described the remarkable result I obtained by this mode of administration in a typhoid case in a condition of extreme adynamia and in great danger of fatal collapse. The alcohol may be simply prescribed in the form of old brandy, 2 to 6 teaspoonfuls in ½ wineglassful of water in which sugar has been dissolved. Were it not for the cinnamon, Todd's mixture could well be administered by this route.

ETHER, when inhaled, is slightly vasodilator as well as stimulant in action. The French official syrup of ether contains 0.4 gram (8 minims) of ether in each tablespoonful. It is currently used in threatened or actual collapse. It acts in a manner similar to alcohol, already referred to. *Subcutaneous injections of ether* have long found much favor in syncope and heart weakness; they cause considerable pain. I much prefer to use camphor in oil, caffeine, physiologic saline solution, and subcutaneous injections of oxygen. A 10 per cent. solution of *ether in camphorated oil* is very serviceable.

[*Spiritus ætheris,* N. F., Hoffmann's drops, 32.5 per cent. of ether, 4 c.c. (1 fluidram).

Spiritus ætheris compositus, N. F., Hoffmann's anodyne, same percentage of ether plus 2.5 per cent. of ethereal oil, 4 c.c. (1 fluidram)].

AMMONIUM COMPOUNDS.—*Ammonia water,* a solution of ammonia gas (NH_3) in distilled water [9.5 to 10.5 per cent. of the gas by weight, U. S. P.], has long been recommended in alcoholic intoxication as a diffusible stimulant in doses of 15 to 30 drops in a little sweetened water.

Ammonium acetate ($CH_3.COO.NH_4$) is much used in the form of an official solution [*Liquor ammonii acetatis,* U. S. P., "spirit of Mindererus"] containing not less than 7 per cent. of the acetate.

It acts as a stimulant to the nervous system and heart, as well as a diaphoretic and expectorant, and is of particular value in broncho-pulmonary affections with a tendency to heart flagging.

It may be given in liquid preparations in doses of 5 to 20 grams (75 grains to 5 drams) a day.

(*a*) ℞ Ammonii acetatis .... 5 grams (gr. lxxv);
Todd's mixture .... 150 c.c. (f℥v).
M. Sig.: To be taken in divided amounts in 24 hours.

(*b*) ℞ Ammonii acetatis .... 5 grams (gr. lxxv);
Extracti cinchonæ .... 2 grams (gr. xxx);
Todd's mixture .... 150 c.c. (f℥v).
M. Sig.: To be taken in divided amounts in 24 hours.

(*c*) The above-mentioned stimulating remedies are happily combined in the following mixture, which is serviceable in angina and fainting spells:

℞ Ammonii acetatis .... 4 grams (ʒj);
Spiritus vini vitis .... 20 c.c. (fʒv);
Syrupi ætheris (2 per cent.) .... 30 c.c. (f℥j).
M. Sig.: To be given in tablespoonful doses in circulatory depression.

Ammonium chloride, which is less stimulating than the acetate, may be prescribed similarly in daily doses of 0.5 to 1.5 grams (8 to 24 grains). It can, if necessary, be given in cachets each containing 0.25 gram (4 grains), 3 to 6 a day being ordered.

These diffusible stimulants played a very important rôle in the therapeutics of bygone ages, as exemplified in the countless formulas of "vulneraries" devised by the ancients, *e.g.,* melissa waters, vulnerary spirits, vulnerary waters, aromatic tinctures, Hoffmann's balsam of life, elixir of Garus, tincture of arnica, etc.

All of these are essentially alcoholic distillates of aromatic plants (melissa, mint, salvia, thyme, absinth, rosemary, etc.), of spices (cinnamon, nutmeg, ginger, pepper, etc.), and of arnica.

CAFFEINE AND KOLA.

These are well-known stimulants to the nervous system and circulation.

CAFFEINE is one of the active principles of coffee and of the kola nut. As a matter of fact, it is now prepared synthetically from the uric acid of guano. It is a trimethylxanthin [$C_8H_{10}NO_2H_2O$].

Its stimulating action on the nervous system, heart-muscle and kidneys renders it valuable as a rapidly acting neuro-cardiac stimulant and diuretic.

It is given hypodermically or in solutions or solid preparations.

Solution for injection:

℞ Caffeinæ .... 2.5 grams (gr. xxxviij);
Sodii benzoatis .... 3.5 grams (gr. liv);
Aquæ destillatæ .... 10 c.c. (f℥iiss).
Contains 0.25 gram (4 grains) of caffeine per c.c. (16 minims).
[*Caffeine sodio-benzoas,* U. S. P., hypodermic dose, 0.2 gram (3 grains).]

Mixture:

℞ Caffeinæ .... 0.3 gram (gr. v);
Sodii iodidi .... 0.6 gram (gr. x);
Sodii benzoatis .... 3 grams (gr. xlv);
Syrupi aurantii florum .... 45 c.c. (f℥iss);
Aquæ ....q. s. ad 200 c.c. (f℥vi⅔).
M. Sig.: Three to five tablespoonfuls in the 24 hours (for *asthma* or *emphysema*).

Cachets [or powders]:

℞ Caffeinæ .... 0.05 gram (gr. ¾);
Exalgin .... 0.1 gram (gr. iss);
Acetphenetidini .... 0.2 gram (gr. iij);
Antipyrinæ .... 0.4 gram (gr. vj).
Ft. cachet. No. i. Da tal. No. xij.
Sig.: One to 3 cachets at hourly intervals (for *neuralgia*).

KOLA, or **COLA,** is obtained from the seeds of *Cola acuminata* (Sterculiaceæ), which in the fresh state contain a soluble tannoglucosid embodying the entire caffeine content. The dry preparations owe their activity solely to the caffeine (about 2 per cent.) and theobromine (about 1 per cent.) they contain.

It is a nervous, cardiac and vascular tonic and diuretic in asthenic and adynamic states in general, *e.g.,* those following infectious diseases, neurasthenoid conditions, nervous exhaustion, etc.

The French Codex recognizes an extract of kola, containing at least 10 per cent. of caffeine; a fluidextract, at least 1.25 per cent.; a granular saccharate, of about the same strength as the kola seeds, and a wine of kola.

[*Kola,* N. F., 4 gram (1 dram).

Fluidextractum kolæ, N. F., 4 c.c. (1 fluidram)].

Kola lends itself to many combinations with cinchona, coca, and glycerophosphates. A much-used French proprietary has the following formula:

Calcium glycerophosphate	4 grams	(ʒj);
Cocoa (vanilla-flavored)	3.2 grams	(gr. xlviij);
Extract of kola	0.5 gram	(gr. viiss);
Extract of cinchona	0.2 gram	(gr. iij);
Caffeine	0.5 gram	(gr. viiss);
Sugar	100 grams	(℥iii⅛).

It is prescribed in doses of 2 or 3 teaspoonfuls a day.

B.—DRUGS ACTING ON THE VASCULAR SYSTEM.

While such a classification may be open to criticism, the drugs acting on the blood-vessels may, following a time-honored custom, be roughly divided into the following two opposed groups:

Vasoconstrictors, raising the blood-pressure at least temporarily: *Adrenalin* and *ergot,* acting mainly on the arteries; *hamamelis* and *hydrastis,* acting mainly on the veins. The nerve tonics, such as *strychnine,* also participate in this action.

Vasodilators, lowering the blood-pressure at least temporarily under certain conditions, and represented especially by the *nitrites* and the *iodides.* The nerve depressants (*bromides, hydrated chloral, valerian, hypnotics, analgesics*) also participate in this action.

VASOCONSTRICTOR AGENTS.

ADRENALIN.—Though known to the profession only about two decades, adrenalin or epinephrin, a compound extracted from the suprarenal capsules, may certainly be said to be one of the drugs that have acquired a definite place in current pharmacology. Its applications have become almost innumerable, alike in general medicine and in otorhinolaryngology, ophthalmology, urology, gynecology, odontology, etc. These applications, which need not be enumerated here, are dependent upon the six essential, specific pharmacodynamic properties of adrenalin:

1. *Vasoconstrictor, blood-pressure-raising action,* whence its use as hemostatic (vasoconstriction) and circulatory stimulant in low blood-pressure, collapse, shock, etc.; in hemorrhagic diseases, and to counteract the untoward effects of arsphenamin.

2. *Substitution for the adrenal secretion,* its use being thus indicated in adrenal insufficiency: Addison's disease, osteomalacia, rickets, infectious diseases and collapse.

3. *Selective stimulant action on the sympathetic,* antagonizing the pneumogastric, thus making it practically specific as an *anti-asthmatic* in some cases.

4. *Re-inforcing action in respect of alkaloids* such as eserine, cocaine, etc.

5. *General tonic action, synergistic with remineralizing medication:* Tuberculosis.

6. Stimulant action on gastric secretion and motility in hypotonic subjects (Loeper): Action of adrenalin on the digestive tract, *Soc. de biol.,* July 28, 1917).

* * *

The *anti-asthmatic action of adrenalin* is one of its most clear-cut actions and one of the most suggestive from the theoretic standpoint. One may consider almost as a clinical certainty, in many cases, the practically specific action on the asthmatic paroxysm, and as an experimental certainty, the arrest of an analogous attack by removal of spasm of bronchial muscle tissue.

What is the exact nature of this action?

The most generally accepted view is that which attributes it to a *selective stimulation of the sympathetic,* the latter being the antagonist of the pneumogastric excitation of which is at the bottom of the broncho-spasmodic reflex. This is in accord with the *general pharmacologic action of adrenalin,* the essential property of which is precisely a *selective stimulation of the sympathetic system.*

It is also possible, however, that adrenalin may act on the endings of the vagus itself after the same fashion that curare acts on the motor nerve-endings.

At any rate, in asthma adrenalin may be administered either hypodermically—1.5 c.c. (24 minims) of the 1 : 1000 solution—or by spraying into the nose. As a result, the spasm disappears within a few minutes, respiration is restored, and the paroxysm comes to an end. Bronchoscopy carried out at this time has revealed ischemia and pallor of the bronchial mucous membrane.

* * *

Sergent regulates the **dosage** of adrenalin as follows:

"In **syndromes of acute adrenal insufficiency,** the vomiting and gastric intolerance necessitate the use of injections. Under these conditions adrenalin should be prescribed in large doses. One should not hesitate to give 5 or 6 mgm. (1/12 or 1/10 grain) or even more in the 24 hours; in one case I gave 8 mgm. (1/8 grain)." Sometimes it is advantageous to supplement this active medication with cachets of

powdered adrenal and hypophysis, as adrenalin by no means represents the whole of the active portion of the suprarenals, if, indeed, it is not merely an excretory derivative thereof.

In the **slowly progressive syndromes,** the dosage of adrenalin is naturally smaller and depends on the extent of failure of the adrenal function. "While, in the majority of cases, 1 to 2 mgm. ($\frac{1}{65}$ to $\frac{1}{32}$ grain) of adrenalin a day is sufficient, . . . there are cases in which the dosage should be much greater." The author mentions in illustration a case of Addison's disease in which a dosage of 5 mgm. ($\frac{1}{12}$ grain) a day was reached, with additional use of 0.3 gram (5 grains) of dried suprarenals.

Lastly, in the presence of **morbid conditions having little or no relationship to adrenal insufficiency,** the doses of adrenalin should be still smaller, and it may be administered by the mouth if there is no gastric intolerance. Thus, in the adrenalin-calcium treatment of tuberculosis, Sergent generally prescribes 1 to 1.5 mgm. ($\frac{1}{60}$ to $\frac{1}{40}$ grain) a day and almost never resorts to injections.

* * *

Adrenalin, *however administered* (ingestion or injections), **should always be prescribed in fractional doses.**

It is well not to incorporate the adrenalin in mixtures that might destroy it and thus render it inert, but to obtain it with a clean medicine dropper from the original solution and have it ingested immediately in a little water. Lastly, when adrenalin is being added to physiologic saline solution, the admixture should be carried out, not before sterilization, but at the moment of injection.

Where the drug is used BY INGESTION, the doses should be taken between meals; the individual doses should not exceed 12 to 15 drops at the most, and should be separated by intervals of *at least* 2 hours.

Where it is given BY INJECTION, not more than 0.5 mgm. ($\frac{1}{130}$ grain) should ever be injected at one point, and the drug should be in solution in at least 1 c.c. (16 minims) of the menstruum; in a serious case, however, this dose may without fear be injected in 2, 3 or 4 different places. Finally, an interval of 2 hours should be allowed between 2 injections of 0.5 mgm. each.

As adrenalin is but sparingly soluble in cold water and very readily deteriorates in alkaline solution, though freely soluble and relatively stable in acid solution, its practical use is almost confined to a weak hydrochloric solution of 1:1000 strength.

This solution contains 1 mgm. (1/65 grain) of adrenalin (adrenalin hydrochloride) per cubic centimeter and yields 20 drops per cubic centimeter with the standard medicine dropper.

By suitable dilution of it with physiologic saline solution, solutions of 1:2000, 1:4000, or 1:10,000 strength are readily obtained.

In accordance with the above-mentioned facts, one may prescribe:

Five to 10 drops (0.25 to 0.5 c.c.) of the 1:1000 solution as an initial dose.

Twenty drops (1 c.c.) in 24 hours in a new patient; later, 30 to 40 drops, according to tolerance.

Such medication may be continued if need be, but only for 7 to 10 days at the most.

Furthermore, such administration should not be repeated too frequently, particularly in old persons.

According to indications one may employ:

The oral route (slow action).

The subcutaneous route (painful).

The intramuscular route (route of choice).

The intravenous route (painless, but abrupt and evanescent).

The investigations of P. Carnot and Josserand (*C. R. Soc. de biol.*, 1902, and *Thèse, Paris*, 1903) and of E. Lesné and L. Dreyfus (*C. R. Soc. de biol.*, 1912 and 1913) seem to have shown that adrenalin is affected neither by pepsin nor by trypsin; that it is not changed by its passage through the intestinal capillaries; that the hepatic barrier arrests and modifies ingested adrenalin, and that the rectal route, by virtue of the anastomoses of the hemorrhoidal veins, may lead it directly to the vena cava. Thus, administration by the rectal route results both in greater activity and greater toxicity, such activity and toxicity approaching those of intravenous injection.

* * *

Finally, mention may be made of the excitant, tonic, blood-pressure-raising and sympatheticotonic action of adrenalin, exemplified in the *adrenalin test in hyperthyroidism.* Hypodermic injection of 0.5 c.c. (8 minims) of 1:1000 adrenalin solution results in predisposed subjects in the appearance (or exaggeration) of the well-known manifestations of hyperthyroidism, *viz.*, tachycardia with palpitations, tremor, and nervousness.

ERGOTIN.—This is an aqueous extract of *Claviceps purpurea,* a parasitic fungus growing in rye grains. Ergotin possesses especi-

ally the property of exciting contraction of the smooth muscle fibers of the uterus and of the vessel-walls, especially the arterial walls.

Ergot is thus, above all, a *vascular hemostatic*. It is practically a specific in uterine hemorrhage, in most instances very effectual in bleeding from hemorrhoids, sometimes useful in bronchial hemorrhage, and possibly of service in gastrointestinal hemorrhage and in epistaxis.

In **uterine hemorrhage,** the *hypodermic route* should be given preference:

℞ Extracti ergotæ aquosi (N. F.) .... 2 grams (ʒss);
Aquæ destillatæ .... 10 c.c. (fʒiiss);
Glycerini .... 8 c.c. (fʒij).
M. et sterilisa.
One to 10 c.c. (16 minims to 2½ fluidrams) hypodermically in the 24 hours.

In **hemoptysis the result of passive congestion in heart cases,** the drug may be given in *pill form:*

℞ Digitalis pulveris,
Extracti ergotæ aquosi (N. F.) ....āā 0.05 gram (gr. ¾).
Ft. pil. No. i. Da tal. No. xx.
Sig.: Five to 20 pills in the 24 hours.

In a liquid preparation one might prescribe:

℞ Extracti ergotæ aquosi (N. F.) .... 1 gram (gr. xv);
Syrupi aurantii .... 40 c.c. (fʒx);
Aquæ destillatæ .... 50 c.c. (fʒxiij).
M. Sig.: To be taken in 24 hours in dessertspoonful doses.

In cases of **hemorrhoids,** administration in a *suppository* is required:

℞ Extracti ergotæ aquosi (N. F.) .... 0.2-0.8 gram (gr. iii-xij);
Olei theobromatis .... 4 grams (ʒj).
Ft. suppos. No. i.

HAMAMELIS.—An extract of the bark or of the leaves (collected in the autumn) of *Hamamelis Virginica* (witch hazel) is used. It acts as a tonic, astringent, hemostatic, antiseptic, and vascular sedative, exerting an almost specific action on the walls of the veins, thereby favoring especially the return circulation. [It should be noted that experimental pharmacologic investigations have not supported the view of hamamelis as a drug capable of acting generally on the vessels through systemic absorption. Regarding the next drug, hydrastis, uncertainty still exists.—TRANSLATOR.]

"The objection has been made to hamamelis that its action on varicose veins is quite inconstant and, because of therapeutic failures, the efficacy of its action has been denied. In inflamed varicose veins with marked local tension the morbid manifestations can be made rapidly

to disappear by the use of hamamelis; in many cases, however, the over-distended veins have lost their elasticity and are unable completely to return to their original condition; under these circumstances no drug can restore their parietes and one should not demand of hamamelis more than it can accomplish.

"Again, this remedy may be administered with advantage in some cases of chronic congestion of the uterus or of congestion of the ovaries, in metrorrhagia, and even in a few instances of chronic inflammation of the pharynx and the larynx, with a varicose condition of the veins of the mucous membrane in these structures. In all of such cases, it is likely to do away with the erethism of the inflamed parts and to lead to cessation of blood stasis, thus restoring to the dilated vessels their normal caliber as well as their regular function; to secure this action, however, it is necessary to use preparations rich in oil and in sufficient amount. Lack of therapeutic success should in most instances be ascribed to the overlooking of one of these requisites, and not to the activity of the drug itself." (J. Chevalier.)

Preparations Containing Hamamelis.—For *internal use,* the simplest and perhaps the best preparation is the *fluidextract,* which may be given in a daily amount of 5 to 15 c.c. (1 to 3 teaspoonfuls) in some suitable vehicle, such as sweetened water or an aromatic infusion.

One might prescribe:

℞ Tincturæ vanillæ (N. F.) .... gtt. xx;
Fluidextracti hamamelidis foliorum (N. F.) .... 50 c.c. (fʒxiij);
Syrupi aurantii .... 40 c.c. (fʒx).
M. Sig.: Four to six teaspoonfuls a day.

Or:

℞ Fluidextracti hamamelidis foliorum (N.F.) 20 to 50 c.c. (fʒv-xiij);
Elixiris aromatici .... 250 c.c. (f℥viiiss);
Aquæ destillatæ ....q. s. ad 300 c.c. (f℥x).
M. Sig.: Three to five tablespoonfuls a day.

Or, again:

℞ Vanillini .... 0.01 gram (gr. ⅙);
Fluidextracti hamamelidis foliorum (N.F.),
Fluidextracti hydrastis ....āā 20 c.c. (fʒv);
Spiritus vini vitis .... 30 c.c. (f℥j);
Glycerini .... 100 c.c. (f℥iiiss).
M. Sig.: Three to five teaspoonfuls a day (in a suitable vehicle).

The *distilled extract* of witch hazel is of appreciable service as a mouth wash, either as such or diluted with an equal volume of water or of rose water:

℞ Aquæ hamamelidis (N.F.),
Aquæ rosæ ....āā 100 c.c. (f℥iiiss).
M. Sig.: For external use.

As an ointment for the itching accompanying varicose conditions at the anus as well as for hemorrhoids themselves, one may prescribe, as recommended by Brocq:

℞ Extracti ergotæ aquosi (N.F.)	2 grams	(ʒss);
Fluidextracti hamamelidis foliorum (N. F.)	2 c.c.	(fʒss);
Tincturæ benzoini	10 c.c.	(fʒiiss);
Adipis lanæ hydrosi,		
Petrolati	āā 10 grams	(ʒiiss).

M. Sig.: For external use.

Or:

℞ Epinephrinæ	0.005 gram	(gr. 1/12);
Extracti ergotæ aquosi (N. F.)	2 grams	(ʒss);
Fluidextracti hamamelidis foliorum (N. F.)	2 c.c.	(fʒss);
Unguenti	20 grams	(ʒv).

M. Sig.: For external use.

In a *suppository* for hemorrhoids, hamamelis may be combined thus:

℞ Extracti belladonnæ	0.02 gram	(gr. 1/3);
Cocainæ hydrochloridi	0.03 gram	(gr. 1/2);
Extracti hamamelidis	0.1 gram	(gr. iss);
Orthoform,		
Olei theobromatis	āā q. s.	—M.

Tampons impregnated with hamamelis water are frequently serviceable in ulcerations of the cervix and congestion of the uterus; the *ovular* type of preparation for insertion into the vagina may also be used:

℞ Extracti belladonnæ	0.02 gram	(gr. 1/3);
Extracti hamamelidis	0.1 gram	(gr. iss);
Ichthyol	1 gram	(gr. xv);
Glycerini (solidified)	q. s.	

Ft. suppos. vag. No. i. Da tal. No. vi.

[The ingredients for solidified glycerin are: Gelatin, 1 part; distilled water, 3; glycerin, 6.]

HYDRASTIS.—The rhizome of *Hydrastis canadensis,* of the family Ranunculaceæ, is used. It acts as a vasoconstrictor, and is a substitute for and synergist to hamamelis. The indications for it are similar to those of the latter drug. Aside from this, it acts as a tonic after the manner of cinchona. It also appears to exert a useful solvent action on mucopurulent bronchial secretions.

The *fluidextract* is prescribed in the average dose of 2 c.c. (30 minims) [U. S. P.]. From 20 to 50 drops may be ordered 3 to 5 times daily in a little water sweetened with sugar.

ÆSCULUS HIPPOCASTANUM.—The seeds and bark of *Æsculus hippocastanum* (horse chestnut), of the natural order Sapindaceæ, may be used in hemorrhoids, an extract effectually relieving pain in inflamed piles. It has been used by mouth with asserted success in varicose

veins and has also been considered indicated in the treatment of phlebitis. For a suppository, 0.05 gram (¾ grain) of the powdered extract may be incorporated in 3 grams (45 grains) of cacao butter.

VASODILATOR AGENTS.

IODINE AND IODIDES.

Though the iodides are among the most frequently used drugs in the Pharmacopœia, the manner in which they act is as yet but imperfectly elucidated. Experimentation and clinical observations will permit, however, of describing the indications for their use as follows:

1. **Action on Lymphoid Tissue.**—Iodine may be considered as the specific remedy for lymphoid tissue, the functions of which it excites.

The iodotannic preparations, in particular, exert an unquestionable action in the treatment of lymphatism, scrofula, and post-infectious glandular enlargements.

2. **Marked Stimulating Action on the Processes of Disintegration.**—The easier and more complete oxidation of proteins and autotoxic excrementitious substances; the stimulating action of the drugs on lymphoid tissue, and the antitoxic action exerted against bacteria, coupled with the hydremia which follows the action of the iodides, result in a definite process of drainage of the tissues and their anatomic components, the cells being thus rid of the metabolic wastes. The *manifest anti-asthmatic action* of iodine and the iodides is probably in part accounted for in this way.

3. **Action in Cardiovascular Disorders.**—From a purely objective viewpoint, and discarding all uncertain and, indeed, contradictory theories upon which the use of iodine in cardiovascular disorders has hitherto been based, I have been brought by direct observation to the following conclusions:

Iodine or iodide medication has seemed useful:

1. *In plethoric, full-blooded, hyperuricemic, gouty, hyperglycemic, and diabetic subjects with high blood-pressure, increased blood viscosity,* with the heart hypertrophied and exhibiting no evidences of failure, and *with unimpaired kidneys.* In these cases iodine treatment coupled with suitable diet permits of lowering the blood-pressure and viscosity by reduction of the plethora; of relieving both the heart and kidneys by this means, and consequently, of forestalling the almost inevitable progressive failure of these organs.

2. *In subjects predisposed to venous stasis, with local or general asphyxial appearances, with venous hypertension, arterial hypotension and*

slowed circulation; subjects with phlebitis, varicose veins, cyanosis, asphyxial states, with normal or low blood-pressure, with the blood viscosity high because of increase of the carbon dioxide content of the blood, and in whom iodides correctly administered in conjunction with a heart-tonic bring about the necessary stimulation of heart-action, acceleration of the circulation, diminution of stasis, improvement of gaseous interchanges in the lungs, diminution of carbon dioxide, and diminution of the blood viscosity. In these cases the rise in the blood-pressure (previously low) and the reduction of the viscosity (previously high) coincide with a notable improvement in the circulation and general condition of the patient.

Potassium iodide has, on the other hand, seemed to me contraindicated in all cases of high blood-pressure accompanied by markedly low viscosity; likewise clinically in all subjects in whom the reserve power of the heart or kidneys is nil or slight, in all subjects with manifest renal insufficiency, and a fortiori *in all subjects with an obvious tendency to hemorrhage, as is the case in the majority of sclerotic cases.*

Action on Respiration.—This action is complex.

The pulmonary circulation is activated, whence oxygenation is improved, gaseous interchanges are increased, and there occurs resolution of venous stasis or pulmonary indurations.

The bronchial hyperemia leads to increased glandular activity inducing *bronchial hypersecretion,* and, in consequence expectoration is facilitated, the bronchi are opened up, and this co-operates with the stimulation of the pulmonary circulation to accelerate gaseous interchanges and "de-asphyxiate" the patient; hence the *utility* of the drug *in asthma.*

Finally, by virtue of the previously mentioned action exerted on metabolism in general, and on disintegration processes in particular, including oxidation and destruction of autogenous and exogenous vasoconstrictor toxins, easier and more complete oxidation of proteins, etc., the iodides contribute to the activation of general detoxication.

The Iodides in Syphilis.—Stripped of their supposed specific action, iodides are now considered only as possible adjuncts of mercury.

While devoid of action on the initial lesion, potassium iodide is capable of favorably influencing certain secondary manifestations that are ordinarily rather refractory to mercury, *e.g.,* the *headache* of the secondary stage, coming on late in the day or at night, which disappears in a few days under small doses (about 1 gram—15 grains—a day) of potassium iodide. The erratic and variable *neuralgias* of the same stage; the *painful manifestations affecting the locomotor system* (ostealgia, arthralgia, myalgia, periostitis, etc.); the *secondary syphilides,* dry, sluggish and *re-*

current; the *ulcerative syphilides,* particularly of the pharynx or nasal mucosa; the *onychia,* and the *bone lesions,* commonly refractory to mercury, yield rapidly to mixed treatment. It should be especially borne in mind, however, that the *iodide may be very harmful in patients with laryngeal syphilis,* inducing an edematous congestion which is sometimes fatal.

As for the tertiary manifestations, one cannot but give due recognition to the action of the iodide on certain tertiary lesions. "Administered for gummatous processes, gummas of the skin and mucous membranes, syphilomas of the soft palate and back of the mouth, exostoses, hyperostoses and ulcerogummatous lesions with a phagedenic tendency, treatment with potassium iodide improves, attenuates, and nearly always dissolves such lesions with a truly extraordinary intensity and rapidity of therapeutic action." (A. Fournier.) (See also, under *Mercury,* the combinations of iodide and mercury.)

The Untoward Effects of Iodides are of a Hyperemic Nature.—In large or even in very small doses, in some individuals, iodides give rise to the toxic phenomena known collectively as *iodism.*

The mode of production of these manifestations may be summed up in one word, *viz., hyperemia,* of all grades and with all its consequences, from lacrymation and coryza the result of hyperemic nasal catarrh to purpura.

The commonest iodide manifestations relate to the *respiratory tract.*

Oculonasal catarrh, characterized by lacrymation and coryza, with an inconstant frontonasal headache, is the most frequent condition.

Bronchial catarrh, much less common, is manifested in cough and expectoration.

Edema of the glottis, with its localized pain, labored inspirations, and dyspnea, is one of the most dramatic and serious, though fortunately exceptional, effects of iodism.

By way of skin manifestations, *iodide acne* has mainly been observed, almost as frequently as the oculonasal catarrh.

There has also been described an *iodide cachexia,* with seriously impaired general condition, loss of weight, asthma, and insomnia, brought on by excessive and prolonged iodide medication.

Hepatic or Renal Insufficiency Demands the Greatest Caution in the Administration of Iodides.—It should be noted that while *the frequency and gravity of the toxic iodide manifestations increase in proportion to the dose of iodide* administered, there occur cases of *idiosyncrasy* of so high a degree that edema of the glottis has been known to set in after the ingestion of but 0.5 gram (7½ grains) of the iodide

(Fournier). Renal permeability seems to be the main factor in this connection.

The following practical rules can, therefore, be formulated:

1. The condition of the kidneys and liver should be carefully investigated in any patient undergoing iodide medication.

2. In a patient in whom renal elimination seems normal, one should never begin with a daily amount of iodide exceeding 2 grams (30 grains).

3. The iodide medication should be suspended upon observation of a toxic iodide manifestation that is either pronounced or persistent.

MODES OF ADMINISTRATION.

IODIDES OF POTASSIUM AND SODIUM.

1. *Solution:*

℞ Potassii vel sodii iodidi .... 15 to 30 grams (℥ss-j);
Aquæ destillatæ .... 300 c.c. (f℥x).—S.

This solution contains nearly 0.25 to 0.5 gram (3¾ to 7½ grains) in each teaspoonful, and 1 to 2 grams (15 to 30 grains) in each tablespoonful.

2. *Flavored Solution:*

℞ Sodii iodidi .... 15 to 30 grams (℥ss-j);
Tincturæ aurantii amari,
Syrupi ....āā 120 c.c. (f℥iv).
M. Sig.: One dessertspoonful at each meal.

3. *Enema:*

℞ Tincturæ opii .... gtt. ij;
Potassii iodidi .... 2 to 4 grams (ʒss-i);
Aquæ destillatæ .... 200 c.c. (f℥vij).
M. Sig.: Use as a warm enema, to be retained.

4. *Intravenous Injections:*

A sterilized solution containing 0.05 to 0.25 (¾ to 4 grains) of the iodide in each cubic centimeter (16 minims). The amount to be injected in one day is from 0.25 to 0.75 gram (4 to 12 grains).

IODOTANNIC PREPARATIONS:

1. *Syrup of iodotannin,* recognized in the United States as *Syrupus iodotannicus,* N. F., which represents iodine, 0.27, and tannic acid, 0.54, in syrup, to make 100. Dose: 4 c.c. (1 fluidram), representing approximately 0.01 gram (⅙ grain) of iodine. [The dose of the corresponding French preparation is given as 1 tablespoonful, containing 0.04 gram (⅔ grain) of iodine].

2. *Phosphated syrup of iodotannin* (Girard's syrup). The formula of this French official preparation is:

Monocalcium phosphate (calcium biphosphate)	20 grams;
Syrup of iodotannin	980 grams.

The dose is 1 tablespoonful.

3. *Phosphated iodotannic wine* (Girard's wine). The formula of this French official preparation is:

Iodine	2 grams;
Tannic acid	2 grams;
Alcohol	20 grams;
Syrup	100 grams;
Monocalcium phosphate	20 grams;
Malaga wine	856 grams.

The dose is 1 tablespoonful.

LIPO-IODIC PREPARATIONS:

Lipiodol is an iodized oil obtained by the action of hydriodic acid on an oil from the field poppy. It may be given by *injection* [1 c.c. (16 minims) = 0.54 gram of iodine], 10 to 20 cubic centimeters (2½ to 5 fluidrams) being administered per week, or in *capsules* of 0.5 gram (8 minims), of which 2 to 5 a day are given.

Lipoiodin is an ethyl ester of diiodobrassic ether, containing 41 per cent. of iodine. One to three tablets are given daily after meals.

[Iodipin is a 10 or 25 per cent. iodized sesame oil, given internally in doses of 4 to 8 c.c. (1 to 2 fluidrams) of the 10 per cent. preparation, or hypodermically in doses of 2 to 6 c.c. (½ to 1½ fluidrams) of the 25 per cent. preparation.

Sajodin is a colorless, insoluble powder, chemically calcium monoiodobehenate, containing about 26 per cent. of iodine and 4.1 per cent. of calcium. The single dose is 0.5 gram (7½ grains).—TR.].

IODO-ORGANIC PREPARATIONS:

(a) *Tincture of iodine* (French—10 per cent.) may be given in the morning in doses of 11 to 20 drops in milk (iodized casein) or in albumin water (iodized albumin). [The U. S. P. tincture is of 7 per cent. strength.]

The French official *compound tincture of iodine* is formulated thus:

Iodine	10
Potassium iodide	4
Alcohol	136

[*Liquor iodi compositus,* U. S.P., Lugol's solution: Iodine, 5 per cent., and potassium iodide, 10 per cent., in distilled water. Dose, 0.2 c.c. (3 minims).]

(b) ℞ Tincturæ iodi,
Potassii iodidi,
Glycerini ....āā part. eq.
M. Sig.: Twenty to thirty drops each morning in milk or albumin water.

(c) The commercial *iodo-peptonates* and *iodo-albuminates* may be given in doses of 20 to 30 drops each morning in diluted syrup.

(d) Dufour has advocated in tuberculosis the use of *intravenous injections of an iodobenzomethylformic compound* (*iodaseptin*) containing 42 per cent. of iodine, the remaining 58 per cent. consisting of a benzomethyl compound and urotropin. He recommends its administration in series of 20 injections of 2.5 to 5 c.c. (40 to 80 minims) each, with intervals between series varying with the indications. According to Dufour these injections never induce hemoptysis, and ordinarily are very well borne. There is a possibility, however, of the occurrence of slight dizziness, transient visual disturbances and renal pain, and exceptionally, of temporary "shock" manifestations. The cough, expectoration and general condition are stated to be favorably influenced. In favorable cases, disappearance of tubercle bacilli is stated by Dufour to have occurred.

IODIDE COMBINATIONS:

I.—*Intended to increase tolerance of iodide, viz.*, combinations with atropine, sodium bicarbonate, sodium benzoate, or sodium glycerophosphate:

(*a*) ℞ Sodii benzoatis,
Sodii iodidi ....āā 20 grams (ʒv);
Tincturæ aurantii amari,
Syrupi ....āā 120 c.c. (f℥iv).
M. Sig.: One dessertspoonful three times a day with the meals.

(*b*) ℞ Sodii glycerophosphatis,
Sodii bicarbonatis ....āā 10 grams (ʒiiss);
Sodii iodidi .... 20 grams (ʒv);
Tincturæ aurantii amari,
Syrupi ....āā 120 c.c. (f℥iv).
M. Sig.: One dessertspoonful three times a day.

II.—*Actual therapeutic combinations:*

1. With *arsenic:*

℞ Sodii arsenatis .... 0.1 gram (gr. iss);
Sodii iodidi .... 5 grams (gr. lxxv);
Aquæ destillatæ .... 100 c.c. (f℥iij).
M. Sig.: One teaspoonful three times a day with the meals. (One teaspoonful contains approximately 0.004 gram (1/16 grain) of sodium arsenate and 0.2 gram (3 grains) of iodide.)

2. With *arsenic* and a *bromide:*

℞ Sodii arsenatis	0.15	gram	(gr. iiss);
Sodii iodidi	8	grams	(ʒij);
Sodii bromidi	15	grams	(℥ss);
Tincturæ aurantii amari,			
Syrupi ... āā	60	c.c.	(f℥ij).

M. One teaspoonful three times a day with the meals (in *asthma*).

3. With *mercury* (see *Mercury*).
4. With *eupneic agents,* such as caffeine, codeine, and lobelia:

℞ Extracti opii	0.1	gram	(gr. iss);
Potassii iodidi	10	grams	(ʒiiss);
Tincturæ lobeliæ,			
Tincturæ senegæ ... āā	10	c.c.	(fʒiiss);
Aquæ destillatæ vel syrupi	300	c.c.	(f℥x).

M. Sig.: Two to four tablespoonfuls in the 24 hours (in *asthmatoid dyspnea*).

Incompatibilities.—One should avoid giving *calomel,* at least in large doses, to a patient taking iodides, as there is a possibility of the formation of a highly irritating and toxic iodide of mercury; it is even more necessary, for the same reason, to avoid combining potassium iodide and calomel in a prescription.

In general, *all salts of the heavy metals* are incompatible with the iodides.

Acids are, for the most part, capable of decomposing the iodides and, through a secondary reaction, setting free iodine. The same is true of *hydrogen peroxide.*

Solutions of alkali iodides also have the property of precipitating solutions of *some of the alkaloids,* in particular the bisulphate of quinine.

There is likewise incompatibility between the iodine group and *galenical preparations rich in tannin,* such as tinctures, and especially, extracts.

IODINE AND IODIDES.

	Pharmaceutic Forms.	Maximum Doses — Single	Maximum Doses — Daily	Pharmacodynamic Properties.	Clinical Indications.	Contra-indications.	Remarks.
IODINE. Tincture. Compound tincture.	*External use.* *Internal use.* In milk or albumin water.	According to tolerance. 10 to 40 drops.	According to tolerance. 10 to 40 drops.	Vasodilator (?) Stimulant to lymphoid tissue. Stimulant to katabolism.	**Lymphatism.** *Post-infectious states.* *Asthma.* *Obesity.* *Plethora.*	*Sometimes poorly borne by the stomach.*	Be on guard for *iodism*, especially in subjects with renal or hepatic impairment. *The commonest manifestations of iodism are:* Oculonasal catarrh. Bronchial catarrh. *Skin manifestations* (acne, purpura). *The most serious manifestations are:* Edema of the glottis. Renal block. *Make it a rule:* 1. To inquire carefully into the condition of the kidneys and liver before prescribing iodides. 2. In a new patient whose degree of tolerance is unknown, to begin with very small doses and increase only with caution.
IODIDES. Potassium iodide. Sodium iodide. Iron iodide.	Solution. Enema. Do. Official syrup (*Syrupus ferri iodidi*, U.S.P.)	1 to 2 grams according to tolerance. Do. 1 to 4 c.c.	15 grams. Do.	Resolvent. Induces hyperemia (vasodilator). Liquefier. Eliminant. Anti-syphilitic. Lymphagogue. Stimulant to hemoglobin production.	1. **Plethora**, *gout, diabetes with high blood-pressure and viscosity and with kidneys and heart unimpaired.* 2. **Those predisposed to venous stasis; hyposphyxia.** 3. **Tertiary syphilis.** *Asthma.* 4. *Anemia and scrofula.*	*High blood-pressure with low viscosity.* *Advanced renal changes.* *Tendency to hemorrhages.* *Laryngeal affections.*	
ORGANIC IODINE PREPARATIONS. Iodized oils (Lipiodol; iodipin.) Iodo-albuminates. Iodo-peptonates. Iodo-casein, etc.	Hypodermic injections. Oral route. Drops.	According to tolerance. 5 to 20 c.c. According to tolerance, in 10 to 20 drop doses.	According to tolerance. 5 to 20 c.c. According to tolerance, in 10 to 20 drop doses.	Stimulant to lymphoid tissue. Stimulant to katabolism. Anti-syphilitic.	**Plethora.** *Venous stasis.* **Syphilis.** *Tendency to* **sclerosis.** *Post-infectious glandular enlargements.*	*The gastric intolerance met with in some subjects may lead to preference of the hypodermic route.*	
IODO-TANNIC PREPARATIONS.	Syrups. Wines.	According to tolerance, in tablespoonful doses or less.	According to tolerance, in tablespoonful doses.	Particularly serviceable in children.	*Lymphatism. Scrofula.* *Infectious and post-infectious glandular enlargements.* *Parenchymatous nephritis.*		

THE NITRITES.

Colonel Champion, during the siege of Paris in 1870-1871, found that soldiers working in the dynamite magazines (dynamite being a mixture of nitroglycerin with an inert powder, sand or silica) developed various cerebral and circulatory disturbances. This observation was the starting-point of the investigations of Bruel, Huchard and F. Franck, and led to the introduction of the nitrites into therapeutics, chiefly as hypotensor agents.

The practically specific vasodilator action of the nitrites of the alkalies, the alcoholic nitrites (amyl nitrite) and certain nitrate esters (nitroglycerin and erythrol tetranitrate) appears to be related to the nitrous group, NO_2.

Their vasodilator and hypotensor action is unquestionable, but temporary and evanescent. Prolonged or repeated action of these agents exerts a depressing action on the heart-muscle which makes it wise to avoid their continuous use in chronic cases. They may, however, constitute excellent agents for emergency use.

The nitrites in common use comprise:

AMYL NITRITE, $C_5H_{11}NO_2$.—This is a yellowish liquid, which volatilizes when exposed to the air, yielding a strong, penetrating, ethereal odor. It is supplied in small ampules or pearls containing a few drops of the nitrite. The pearl is broken in a handkerchief and given to the patient to inhale during an attack of high blood-pressure. The vasodilatation at once obtained generally induces an intense congestion of the face and of the upper part of the chest, sometimes with a sensation of heat or even dizziness, and reduction of the precordial discomfort and constriction. From this standpoint it is a very valuable drug.

As is well known, **ETHYL IODIDE,** which is similar in appearance and is administered under like conditions, produces the same effect.

SODIUM NITRITE, $NaNO_2$, which occurs in the form of deliquescent crystals, soluble in water, has a much less pronounced—in fact, much more doubtful—action. Huchard prescribed it for continuous, prolonged treatment in an average dosage of 0.2 to 0.5 gram (3 to 7½ grains). He ordered:

℞ Sodii nitritis	2 grams	(ʒss);
Potassii nitratis	10 grams	(ʒiiss);
Sodii bicarbonatis	20 grams	(ʒv);
Aquæ bulliatæ	q. s. ad 270 c.c.	(f℥ix).

M. Sig.: Two tablespoonfuls daily.

NITROGLYCERIN, or glyceryl trinitrate, $C_3H_5(NO_3)_3$, is an oily liquid, insoluble in water, soluble in absolute alcohol. It is in great vogue among the English-speaking practitioners, who look upon it as somewhat of a specific for angina pectoris. When properly and cautiously employed, it is capable of rendering appreciable service in this condition as a powerfully but transiently acting vasodilator.

It is supplied and used in the following forms:

1. *Tablets* containing 0.5 or 1 milligram (1/130 or 1/65 grain), to be allowed to dissolve under the tongue during the paroxysm [*Tabellæ trinitrini,* B. P., each containing 0.5 milligram (1/130 grain).—*Pilulæ glycerylis nitratis*, N. F. IV, each equivalent to 0.00065 gram (1/100 grain) of nitroglycerin.]

2. A 1 per cent. *alcoholic solution* [*Spiritus glycerylis nitratis,* U. S. P.], of which 3 to 6 *drops* (0.5 to 1 mgm. of nitroglycerin) may be given by mouth during the paroxysm in a little water or infusion or on a lump of sugar.

One might also prescribe:

℞ Spiritus glycerylis nitratis .... gtt. xxx;
Aquæ bulliatæ .... 300 c.c. (f℥x).
M. Sig.: Two tablespoonfuls daily.

3. A 1 : 2000 *hydro-alcoholic solution* for hypodermic injection:

℞ Spiritus glycerylis nitratis .... 1 c.c. (♏xvj);
Aquæ destillatæ .... 20 c.c. (f℥v).—M.

Of this solution 0.5 to 1 c.c. (8 to 16 minims), containing 0.25 to 0.5 mgm. (1/260 to 1/130 grain) of nitroglycerin, may be injected 2 or 3 times a day, according to indications.

As nitroglycerin is subject to rapid evaporation and deterioration, the bottle containing it should be carefully stoppered and the preparation frequently renewed.

ERYTHROL TETRANITRATE, or tetranitrol, $C_4H_6(NO_3)_4$, exerts an action similar to that of nitroglycerin, but more prolonged.

It is supplied in tablets and given in a daily dosage of 0.002 to 0.04 gram (1/32 to 2/3 grain). [In this country the *single* dose is generally given as 1/2 to 1 grain (0.03 to 0.06 gram).—Tr.].

No compound of the nitrite group can cause a lasting reduction of blood-pressure. Tolerance is rapidly established and increase of dosage may bring on unpleasant symptoms. In the long run the nitrites seem to exert an unfavorable effect on the heart muscle.

ARTIFICIAL SERUMS OR SALINE SOLUTIONS.

The term "artificial serums" has sometimes been used to designate saline solutions having a composition more or less similar to that of the blood serum. The word "serum," is, however, very misleading when it is applied to saline solutions notably lacking in all protein substances—the "essential" components of blood serum.

The saline solutions may be divided into those which are *isotonic, i.e.,* have a molecular concentration as similar as possible to that of blood serum, and those which are *hypertonic, i.e.,* have a higher molecular concentration than blood serum.

I. **ISOTONIC SOLUTIONS** may be introduced into the human body in large amounts (50 to 500 c.c. or more) by the subcutaneous, intravenous, oral or rectal route (see *Technical Procedures*).

The typical solution is the isotonic, **physiologic** or **normal salt solution,** a 0.75 per cent. solution of sodium chloride. [The U. S. P. *Liquor sodii chloridi physiologicus* is of 0.85 per cent. strength, in distilled water.]

Recent biologic investigations have shown that cell life may be disturbed by the presence of large amounts of sodium. In particular, they have demonstrated that the so-called "physiologic" chloride solutions are capable of compromising the normal functioning of the tissues, inasmuch as the sodium lowers the potassium and calcium content of the cells, especially the nerve cells. Accordingly, there is advantage in using certain newer solutions, the composition of which obviates impairment of the vitality of the tissue cells.

A considerable number of formulas of "artificial serums" have been vouchsafed to meet these requirements. The best known are the following:

(a) *Hayem's solution:*

Sodium chloride	5 grams;
Sodium sulphate	10 grams;
Water	1000 grams.

(b) *Ringer's solution:*

Sodium chloride	6 grams;
Potassium chloride	0.075 gram;
Calcium chloride	0.1 gram;
Sodium bicarbonate	0.1 gram;
Distilled water	1000 grams.

(c) *Locke's solution:*

Sodium chloride	9	grams;
Potassium chloride	0.075	gram;
Calcium chloride	0.1	gram;
Sodium bicarbonate	0.1	gram;
Glucose	1	gram;
Distilled water	1000	grams.

(d) *Fleig's solution:*

Sodium chloride	6 to 8	grams;
Potassium chloride	0.2 to 0.5	gram;
Calcium chloride	0.1 to 1	gram;
Magnesium sulphate	0.2 to 0.5	gram;
Sodium glycerophosphate	0.7 to 2	grams;
Sodium bicarbonate	0.5 to 2.5	grams;
Glucose	1 to 5	grams;
Distilled water	to make 1 liter.	

[(e) *Tyrode's solution:*

Sodium chloride	8	grams;
Potassium chloride	0.2	gram;
Calcium chloride	0.2	gram;
Sodium bicarbonate	1	gram;
Magnesium chloride	0.1	gram;
Disodium hydrogen phosphate	0.05	gram;
Glucose	1	gram;
Distilled water	1000	c.c.]

(f) *Quinton's serum* is sea water obtained at some distance from the shore at a depth of 10 meters, collected aseptically, sterilized by filtration, and brought to *isotonicity* by adding 190 parts of distilled water to 83 parts of the sea water. It contains 8.9 grams of sodium chloride to the liter.

Unless the patient's condition demands prompt action, there is advantage in resorting to recto-colic injections, which are never followed, as is hypodermoclysis, by a rise of temperature. This is due to the fact that the fluid, passing into the portal circulation, undergoes marked changes in the liver, which render it incapable of inducing protoplasmic lesions.

A solution intended for rectal use should be somewhat different in composition, and in particular, should contain a rather large proportion of glucose.

II. **HYPERTONIC SOLUTIONS** are strong solutions, to be used in smaller amounts than the preceding group. Only two well-known formulas will be given here:

Chéron's solution:

Phenol (crystals)	1 gram;
Sodium chloride	2 grams;
Sodium phosphate	4 grams;
Sodium sulphate	8 grams;
Distilled water	to make 100 c.c.

Dose: 1 to 10 c.c.

Trunecek's solution:

Sodium phosphate	0.15 gram;
Sodium carbonate	0.21 gram;
Sodium sulphate	0.44 gram;
Potassium sulphate	0.40 gram;
Sodium chloride	4.92 grams;
Distilled water	to make 100 c.c.

Dose: 1 to 10 c.c. [for *arteriosclerosis* (?)].

The hypodermic route is alone indicated in this connection.

The **recognized indications for the saline solutions** are:

1. To **stimulate** and **raise blood-pressure**; hence their use:

In *conditions of low blood-pressure*—hyposphyxia; post-traumatic, postoperative, or post-hemorrhagic hypotension. Post-traumatic, postoperative, and anaphylactic shock constitute absolute indications for their use.

In *anemic states,* whether spontaneous or following accidental, surgical, obstetrical, or medical (hematemesis, hemoptysis, etc.) *hemorrhage.*

2. The **eliminant, antitoxic indication** ("washing of the blood"):

This may apply in *intoxications of external origin,* as by chloroform, carbon monoxide, alcohol, chloral hydrate, strychnine, opium, barbital, etc.

It has been availed of with varying success in *endogenous intoxications,* such as uremia and eclampsia. Chloride retention and hypertensive nephritis are factors which account for many of the failures. Under these conditions the saline solutions have been almost wholly supplanted by Fleig's chloride-free glycomineral solutions (see below).

3. The **anti-infectious indication**:

Occurring mainly in children suffering from severe forms of enteritis with profuse diarrhea resulting in marked dehydration, and for the same reasons, in Asiatic cholera.

In other infections, the indication for saline solutions is mainly symptomatic, *viz.,* to raise blood-pressure and act as stimulant in infectious and post-infectious states of adynamia with low blood-pressure, and in hemorrhage; also as eliminant and antitoxic in infectious toxemias.

The contraindications are, conversely:

(*a*) High blood-pressure.

(*b*) Chloride retention.

(*c*) Heart failure: In this condition the increased blood-volume resulting from a saline injection could not but aggravate the disturbance of cardiac function.

* * *

Special consideration must be given to the *glucose solutions, chloride-free solutions,* and *medicated solutions* introduced in therapeutics by Fleig, whose painstaking and thoroughgoing studies have led to marked advances in the practice of saline solution therapy.

Among the **chloride-free glucose solutions,** Fleig gives the following formulas:

Isotonic Solutions.

Glucose:

Pure crystalline glucose		45 grams;
Distilled water	to make	1 liter.

Lactose:

Pure crystalline lactose		90 grams;
Distilled water	to make	1 liter.

Mannite:

Pure crystalline mannite		50 grams;
Distilled water	to make	1 liter.

In a general way, to formulate correctly, one should bear in mind that, on account of the difference between the molecular weights of glucose and of saccharose (cane sugar), the strength of the solution should be 4.5 per cent. in the case of glucose and 9 to 9.5 per cent. in that of saccharose or of lactose.

Hypertonic solutions of 20 or 30 per cent. strength are indicated mainly for their tonic action on the heart.

Hypertonic Solutions.

Glucose, lactose, or mannite		300 grams;
Distilled water	to make	1 liter.

Like the chloride-containing solutions already referred to, these produce tonic, blood-pressure-raising, eliminant, and antitoxic effects. They are dehydrating diuretics of extraordinary power. Chloridemia need cause no apprehension in the case of these solutions. One should beware, however, of conditions of excessive dehydration.

They are employed, like the solutions previously mentioned, by either the subcutaneous, intravenous, or rectal route.

Fleig's glycomineral solutions:

Isotonic Solutions.

(*a*) Sodium bicarbonate .... 7 grams;
Pure crystalline glucose .... 25 grams;
Distilled water .... to make 1 liter.

(*b*) Calcium chloride .... 2 to 4 grams;
Sodium glycerophosphate .... 4 to 6 grams;
Pure glucose .... 30 to 35 grams;
Water .... 1 liter.

Hypertonic Solutions.

(*c*) Sodium bicarbonate .... 30 grams;
Pure crystalline glucose .... 100 grams;
Distilled water .... to make 1 liter.

(*d*) Calcium chloride .... 3 to 5 grams;
Sodium glycerophosphate .... 5 to 7 grams;
Glucose .... 150 to 200 grams;
Water .... 1 liter.

The procedures and indications are the same.

Medicated solutions.

Either the chloride-containing or the chloride-free solutions may be converted into medicated solutions by the addition of various substances.

Following are a few formulas, likewise reproduced from Fleig:

Bromide solution:

Sodium bromide .... 10 grams;
Glucose .... 15 grams;
Distilled water .... to make 1 liter.

Dose: One-half liter (in *epilepsy* or *eclampsia*).

Diuretic solutions (dose: ½ liter):

Isotonic.

Theobromine .... 1 gram;
Trisodium phosphate .... 4 grams;
Pure crystalline glucose .... 20 grams;
Distilled water .... to make ½ liter.

Hypertonic.

Theobromine .... 1 gram;
Trisodium phosphate .... 4 grams;
Glucose .... 120 grams;
Distilled water .... to make ½ liter.

Diuretic caffeine solutions (dose: ½ liter):

Isotonic.

Caffeine		0.5 gram;
Pure crystalline glucose		20 grams;
Distilled water	to make	½ liter.

Hypertonic.

Caffeine		0.5 gram;
Glucose		120 grams;
Distilled water	to make	½ liter.

Fleig states: "The hypertonic solution, injectable only into the veins (½ liter), is particularly useful as a diuretic and heart-tonic."

There are commercially available and described in formularies relating to hypodermic medication countless hypodermic formulas—sometimes called "serums"—containing strychnine, arsenicals, glycerophosphates, sparteine, caffeine, etc.; these, as a rule, are merely solutions of varying strength of these various substances in distilled water or in physiologic salt solution.

Injections of saccharose, recently brought forward and inconsiderately lauded to the skies, appear to constitute a useful auxiliary measure in bronchorrhea and in sweats.

* * *

An important point relative to artificial serums has been brought to light in connection with the study of their use in shock. By reason of the non-colloidal nature of purely saline electrolytic solutions, the water and salts are rapidly eliminated by the kidneys, and the effect of the saline injection lasts but a short time. **Addition of a colloid,** such as gelatin (Hajan), glucose and lactose (Richet), or gum arabic (Bayliss) is capable of bringing about a lasting increase of the blood-pressure. The salt by itself fails to keep up the blood-volume sufficiently. THIS FEATURE IS CLOSELY RELATED TO THE QUESTION OF BLOOD VISCOSITY.

The majority of Fleig's solutions are possessed of this property.

Following are two more recent formulas:

(1)	Sodium chloride	7 grams;
	Glucose	5 grams;
	Water	1 liter.

(C. RICHET.)

(2) Sodium chloride .... 1.5 grams;
Pure gelatin .... 25 grams;
Distilled water .... 100 c.c.

Boil, filter, place in the autoclave at 124° C. for an hour, and allow to cool to a solid consistency.

When required for use, warm the product to restore its fluid consistency and add:

Sodium carbonate (crystalline) .... 2 grams;
Sodium chloride .... 9 grams;
Distilled water .... 1000 grams.

To be used for intravenous or intramuscular injections at body temperature.

(HAJAN.)

C.—DIURETIC DRUGS.

Many **classifications** of the diuretics and of diuretic treatments have been suggested, but all have been in some manner defective. This is true, indeed, of the majority of our classifications. Actual conditions, in their infinite complexity, do not always, nor even often, lend themselves to a precise division into categories. Nonetheless, such attempts at grouping and at synthetic reconstruction are of considerable value, provided the minds of their authors sufficiently combine experience and logic.

If one tries to group the diuretic measures according to their predominant action, *e.g.*, on the heart (effect on blood-pressure), on the blood (effect on viscosity), or on the renal vessels and epithelium, the classification shown on the next page may be offered:

It is more convenient to adopt, with Pic and Castaigne, a classification of the diuretics "according to their total or selective action on the elimination of individual constituents of normal urine," and which accordingly divides them into three main groups: Hydruric, chloriduric, and azotemic.

1. HYDRURIC DIURETICS.

These increase especially the excretion of water.

They are represented by:

(*a*) **Water,** taken by the mouth or by enema, and certain mineral spring cures. The water prescribed should contain as little mineral matter as possible, and be ordered taken between meals, preferably in the course of the morning.

(*b*) **Infusions,** which share the foregoing properties, and the action of which may be re-inforced by the addition of certain well-known substances:

Diuretic Drugs.

Heart-tonics (cardiac action).	(*a*) Digitalis, strophanthus, sparteine, strychnine. (*b*) Camphor in oil, subcutaneous oxygen injections. (*c*) Physical training. (*d*) Baths and cold hydrotherapy.
Viscosity-reducers (action on blood).	(*a*) Hydriatic cures, infusions. (*b*) Iodides, sodium citrate. (*c*) Subcutaneous oxygen injections. (*d*) Possibly calcium chloride and copious fluid intake. (*e*) Possibly the uricolytic drugs.
Vasodilators (vasculorenal action).	(*a*) Caffeine, theobromine. (*b*) Digitalis, squill. (*c*) Hydriatic cures. (*d*) Sodium nitrite. (*e*) Chloral hydrate, urethane. (*f*) Uricolytic agents: Lithia, piperazin, lycetol, methenamine. (*g*) Mercurial salts.

In a general way, all substances foreign to the organism, in their progress toward elimination, and most commonly by the renal route, exert a more or less pronounced and serviceable diuretic action. The function of diuresis is, at bottom, one of the commonest processes in pharmacodynamics. Thus, mercury is ordinarily very active as a diuretic.

This attempt at a classification is of some interest in that it may form a basis for really practical therapeutic suggestions. It is imperfect in more than one respect. The majority of the measures enumerated overlap into the other groups.

(1) *Corn-silk* or *triticum,* in an infusion of 30 grams (1 ounce) in 1 liter (quart) of water.

(2) *Juniper berries,* in an infusion of 10 grams (2½ drams) in 1 liter (quart) of water.

(3) *Uva ursi,* likewise in an infusion of 10 grams in 1 liter.

(4) A *combined infusion* of five diuretic roots, *viz.,* those of asparagus, of *Ruscus aculeatus,* of parsley, of fennel, and of the marsh-nettle—constituents of the French official "sirop des cinq racines." The infusion is made with 4 grams (1 dram) of each ingredient in 1 liter (quart) of water.

(5) *Leek* or *white onion bouillon,* long a popular lay remedy in France, and recognized as effective in relatively recent clinical experience.

Carles has published a formula for onion wine which may be of some service:

Ripe, raw onions .... 100 grams;
Clarified honey .... 50 grams;
White wine .... to make 500 grams.

Fifty grams of the wine thus contain 10 grams of onion.

(*c*) **White wine** and **grape juice,** or grapes as such.

The diuretic action of white wine is unquestionable, though anti-alcoholic enthusiasm has sometimes sought to deny it. *Grape cures* and *fruit cures in general* are diuretic both by reason of the water and the glucose and various salts they contain. There is every reason, from this viewpoint, to encourage the dietetic use of fresh grape juice.

(*d*) **Sugars** are all more or less actively diuretic.

Lactose, glucose, and saccharose exhibit obvious diuretic properties, both hydruric and azoturic, though the hydruric property predominates.

Their complex action seems to be exerted as much through a dialytic process (marked change of osmotic tension) as through stimulation of the renal epithelium and of the heart.

The sugars enjoy an immense practical advantage in that they may be administered either *by the mouth, subcutaneously,* or *intravenously.*

Oral route:

Lactose .... 30 grams (1 ounce) a day.

To be taken in teaspoonful or tablespoonful amounts in infusions.

Subcutaneous route:

Sterilized, isotonic glucose solution (4.5 per cent.).

250 to 500 c.c. (½ to 1 pint) a day by hypodermic injection.

Intravenous route (in emergencies):

Sterilized 25 per cent. glucose solution.

250 to 500 c.c. (½ to 1 pint) a day by intravenous injection.

The diuretic action of these glucose solutions is sometimes striking. I have seen it reach enormous amounts and at times bring about an alarming state of dehydration which, in a few instances, was remedied only with great difficulty.

2. CHLORIDURIC DIURETICS.

These are the agents which, while increasing the volume of urine, simultaneously enhance the elimination of sodium chloride to a relatively greater extent than that of the other urinary constituents.

They are represented mainly by the *xanthin compounds* and the *chlorides.*

I.—XANTHIN COMPOUNDS.

(*a*) **Caffeine.**—This is chemically trimethylxanthin. It is one of the active principles in coffee, tea, and kola; it is produced commercially from the uric acid of guano. It has a very distinct, direct diuretic action, which is, however, less pronounced and less constant than that of theobromine. It may be prescribed in solutions or in cachets; a solution may be administered hypodermically.

1. ℞ Caffeinæ,
   Sodii benzoatis,
   Potassii iodidi ....āā 2 grams (ʒss);
   Syrupi .... 100 c.c. (f℥iij);
   Aquæ aurantii florum ....q. s. ad 300 c.c. (f℥x).
   M. Sig.: One to three tablespoonfuls a day.

2. ℞ Caffeinæ .... 2.5 grams (gr. xxxviij);
   Sodii benzoatis .... 3 grams (gr. xlv);
   Aquæ destillatæ ....q. s. ad 10 c.c. (fʒiiss).
   This solution is for hypodermic injection: 1 to 2 c.c. (16 to 32 minims) in 24 hours.
   [*Caffeine sodio-benzoas,* U. S. P., may be used in its preparation.]

Caffeine being a nervous stimulant which readily induces restlessness and insomnia, its use in the evening should preferably be avoided.

(*b*) **Theobromine.**—This is extracted from cacao (*Theobroma cacao*) and from kola nuts. It is chemically a dimethylxanthin, $C_7 H_8 N_4 O_2$. "It is the most reliable, constant and harmless of the diuretics." (Huchard.)

It is especially effective in uricemia, incipient arteriosclerosis, and particularly, in *chloridemic* cases.

It is almost insoluble in water—1:1400—and the other solvents, and may be prescribed as such in cachets or with adjunct remedies:

1. ℞ Theobrominæ .... 0.5 gram (gr. viiss).
   Pone in cachet. No. i. Da tal. No. xx.
   Sig.: Four to eight cachets a day.

2. ℞ Theobrominæ .... 0.3 gram (gr. v);
   Sodii benzoatis,
   Lithii carbonatis ....āā 0.15 gram (gr. iss).
   Pone in cachet. No. i. Da tal. No. xxx.
   Sig.: One cachet morning and evening (in *arteriosclerosis with renal insufficiency*).

3. Combination with sodium salicylate greatly increases the solubility of theobromine:

℞ Theobrominæ,
Sodii salicylatis .... āā 0.5 gram (gr. viiss).
Pone in cachet. No. i. Da tal. No. vi.
Sig.: One to three a day in water.

[*Theobrominæ sodio-salicylas,* U. S. P., containing at least 46.5 per cent. of theobromine; dose, 1 gram (15 grains).]

4. The combination of *theobromine* with *digitalin* is strongly indicated in many cases of cardiac insufficiency with reduced output of urine:

℞ Theobrominæ .... 0.5 gram (gr. viiss);
Crystallized digitalin (French) .... 0.00005 (1/1200 grain).
Pone in cachet. No. i. Da tal. No. xx.
Sig.: Two cachets daily.

5. The combination of *theobromine* with *methenamine* is indicated in many cases of uricemia with reduced urinary output:

℞ Theobrominæ .... 0.3 gram (gr. v);
Methenaminæ .... 0.5 gram (gr. viiss).
Pone in cachet. No. i. Da tal. No. xx.
Sig.: Two or three cachets daily.

When theobromine is poorly borne, which is exceptional, such intolerance is manifested in headache, cerebral excitement and digestive disturbances.

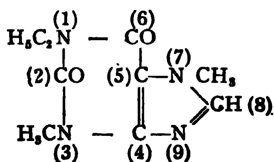
In these cases it is sometimes better borne when combined with sodium benzoate and lithium carbonate (see above) or with sodium phosphate:

℞ Sodii phosphatis .... 0.25 gram (gr. iv);
Theobrominæ .... 0.5 gram (gr. viiss).—M.

Soluble Derivatives of Theobromine.—A valuable pharmacologic advance has been made in the preparation of two soluble derivatives of theobromine:

1. **Lithium theobrominate,** $C_7H_7N_4O_2Li$, is a definite crystalline compound, prepared by Dumesnil and marketed under the name *theobromose.* Its action is more rapid and constant than that of pure theobromine, and it is, as a rule, better borne. Two tablets of this preparation are equivalent to 0.5 gram (7½ grains) of theobromine.

2. **Allyl-theobromine,** $C_{10}H_{12}N_4O_2$, is an allyl-1-dimethyl-3.7-dioxy-2.6-purin having the graphic formula:



By reason of its solubility it is more convenient as well as more active than theobromine, and can be given hypodermically. It is on the market as *theobryl,* in two forms: 1. Ampules of 2 c.c. for subcutaneous, intramuscular or intravenous injection, 2 to 5 a day. 2. Drops for oral use, 1 c.c. = 30 drops; 30 drops are given 3 to 5 times daily.

3. **Sodium homocaffeinate** or **theobrominacetate,** marketed as *técarine* (Poulenc), soluble and neutral, is rapidly absorbed without causing local irritation nor the least general disturbance (no dizziness, headache, etc.).

It is given orally in tablets of 0.25 gram (4 grains), 1 to 3 during the 24 hours; or intramuscularly or subcutaneously, for which it is supplied in ampules containing 0.25 gram per 2 c.c. of liquid, 1 ampule *per diem;* the injections are painless. In exceptional cases it is given intravenously; such injections may cause a slight reaction, but no marked untoward effect.

Pic gives the following diagrammatic table, showing the gradations in the diuretic and cardiac actions of the xanthin derivatives:

Diuretic action increasing from above downward. ↓	*Caffeine (trimethylxanthin).*	↑	*Cardiotonic action increasing from below upward.*
	Theobromine (dimethylxanthin).		
	Theophylline (dimethylxanthin).		

Clinical experience in France has not proven favorable as regards the current use of theophylline, the effect of which has seemed too violent, short-lived, and attended with risk of renal detriment.

II.—CHLORIDES.—(*a*) Late investigations have given **calcium chloride** first place in this connection. Its diuretic, and particularly its chloride-eliminating, action seems unquestionable. As to the manner in which its effect is exerted little is as yet known. At all events, this drug seems to have a most favorable action in **acute** and **subacute nephritis** and in most cases of dropsy, of whatever cause.

Calcium chloride is, as is well known, very deliquescent and its rather unpleasant taste necessitates its administration in a solution flavored with aromatics or in the form of an elixir, *e.g.:*

℞ Calcii chloridi .... 15 grams (℥ss);
Spiritus jamaicensis vel vini vitis .... 90 c.c. (f℥iij);
Tincturæ aurantii amari,
Syrupi .... āā q. s. ad 300 c.c. (f℥x).
M. Sig.: Three teaspoonfuls to three tablespoonfuls a day.

To obtain all of its diuretic effect, it should be combined with a diet markedly poor in sodium chloride.

(*b*) In practice, the calcium salt is about the only **chloride** used as a diuretic. The former vogue of saline solution in uremia has, how-

ever, already been referred to, and likewise its fall from grace since the discovery of chloride retention. Nevertheless, saline solution may serve well in many a case of **uremia** with moderate hypertension, little or no chloride retention, and without tendency to edema.

3. AZOTURIC DIURETICS.

These are the diuretics which cause a proportionally much greater elimination of nitrogenous compounds than of the other urinary components.

Insofar as is now known, this group is represented mainly by *squill* and *formic acid,* and secondarily, as we have already seen, by the *sugars.*

(*a*) The "nestor" among diuretics, **squill,** is here the pre-eminent drug. It is nearly always combined with synergists.

It is prepared from the scales of *Scilla maritima* (*Urginea scilla*).

The *powder* is prescribed in average doses of 0.3 to 0.8 gram (5 to 12 grains) a day.

[*Fluidextractum scillæ,* U. S. P.; dose, 0.1 c.c. (1½ minims).

Tinctura scillæ, U. S. P., 10 per cent., single dose, 1 c.c. (15 minims); daily dose, 2 to 6 c.c. (½ to 1½ fluidrams).

Acetum scillæ, U. S. P., vinegar of squill, 10 per cent.; dose, 1 c.c. (15 minims).

Syrupus scillæ, U. S. P., 4.5 per cent.; dose, 2 c.c. (30 minims).

Syrupus scillæ compositus, U. S. P., Coxe's hive syrup, 8 per cent., with senega and tartar emetic; dose, 2 c.c. (30 minims).]

The *oxymel* of squill [*Oxymel scillæ,* N. F., a mixture of vinegar of squill, 50 parts, with honey, to make 100; dose, 4 c.c. (1 fluidram)] may be given in solid or liquid preparations in daily amounts of 10 to 30 c.c. (2½ fluidrams to 1 fluidounce).

VARIOUS FORMULAS.—A typical combination is that of digitalis, squill and scammony (Trousseau, Lancereaux):

℞ Scillæ pulveris,
Resinæ scammoniæ,
Digitalis pulveris (recentis) ....āā 0.05 gram (gr. ¾).
Ft. pil. No. i. Da tal. No. xx.
Sig.: Four to eight pills a day, according to indications.

This provides a useful combination meeting the heart-tonic, diuretic, and cathartic indications which obtain in the majority of cases of *cardiorenal insufficiency in the stage of decompensation.*

The foregoing formula may, in turn, serve as a foundation for other synergistic combinations calculated to enhance the cathartic or hepatic effect. Thus, in *cardiorenal insufficiency with markedly enlarged liver,* a combination with calomel will often accomplish wonders:

℞ Scillæ pulveris,
Resinæ scammoniæ,
Digitalis pulveris (recentis),
Hydrargyri chloridi mitis .... āā 0.05 gram (gr. ¾).
Ft. pil. No. i. Da tal. No. xx.
Sig.: Four to eight pills a day, according to indications.

In the presence of obstinate constipation, without complicating hemorrhoids, aloe may be substituted for the calomel:

℞ Scillæ pulveris,
Aloes,
Digitalis pulveris (recentis) .... āā 0.05 gram (gr. ¾).—M.

These formulas are subject to manifold variations in accordance with the different clinical needs.

I frequently prescribe with advantage the following combination in cases of *nitrogen retention with a tendency to loss of compensation:*

℞ Tincturæ scillæ .... 6 c.c. (f℥iss);
Tincturæ convallariæ .... 10 c.c. (f℥iiss);
Tincturæ grindeliæ robustæ .... 20 c.c. (f℥v).
M. Sig.: Thirty to fifty drops two or three times a day between meals in a cup of cornsilk infusion.

(*b*) **Formic acid** has been credited with acting both as a general tonic, heart-tonic and diuretic. After being lauded to excess for a time, it has fallen, perhaps without justification, practically into oblivion. It is capable of giving service in azotemic, depressed and oliguric cases.

It is prescribed preferably in the form of *sodium formate:*

℞ Sodii formatis .... 10 grams (℥iiss);
Sodii bicarbonatis .... 2 grams (℥ss);
Spiritus vini vitis,
Tincturæ aurantii amari,
Syrupi .... āā 40 c.c. (f℥x).
M. Sig.: Three to five dessertspoonfuls a day, with the meals.

℞ Sodii formatis .... 3 grams (gr. xlv);
Aquæ destillatæ,
Tincturæ aurantii amari,
Syrupi .... āā 30 c.c. (f℥j).
M. Sig.: To be taken in 24 hours in three doses. (Castaigne.)

* * *

The foregoing classification, however serviceable it may be, is far from having exhausted all the possibilities, and it is well to add to it at least, as specified by Castaigne:

The **diuretics having a complex,** ill-defined **action,** such as urea and the salts of potassium.

The **uricolytic diuretics,** promoting especially the destruction and elimination of uric acid.

1. The POTASSIUM SALTS, the *acetate,* [*citrate*] and *nitrate,* are also long-used and well-tried diuretics, exerting a distinct, but complex and ill-defined action [ascribed to prevention of reabsorption of water from the renal tubules, shrinking of the kidney cells, and reduction of blood viscosity.—TR.].

A *nitrated infusion of triticum* (couch grass), long used in France, is made by dissolving 6 grams (1½ drams) of potassium nitrate in ½ to 1 liter (1 pint to 1 quart) of a 2 per cent. infusion of triticum, boiled one hour, with subsequent filtration and decantation.

Potassium acetate is prescribed in similar dosage.

These salts may be embodied in a liquid preparation containing *squill.* Following is the formula of a very active squill mixture:

℞ Potassii acetatis,
Potassii nitratis .... āā 2 grams (ʒss);
Oxymellis scillæ (N. F.) .... 30 c.c. (f℥j);
Infusi scoparii .... 120 c.c. (f℥iv).
M. Sig.: One tablespoonful every hour.

2. The URICOLYTIC DIURETICS will be described with the alteratives (*q. v.*).

* * *

Lastly, mention should be made of **calomel,** the diuretic effect of which is well known, but the mode of action of which is undoubtedly complex and ill-defined (actions on the liver, the renal epithelium and the blood). This effect, furthermore, is common to all the mercury compounds. Observation of individuals subjected to any form of mercurial treatment is sufficient to bring conviction of this fact. *Calomel* should be prescribed in divided doses of 0.02 to 0.05 gram (⅓ to ¾ grain), with or without addition of another diuretic, such as squill, lactose, theobromine, digitalis, etc. It is especially adapted for hepatic and cardiac cases. In syphilitics, the soluble salts are preferable.

℞ Scillæ,
Scammoniæ,
Digitalis .... āā 0.05 (gram (gr. ¾);
Hydrargyri chloridi mitis .... 0.01 gram (gr. ⅙).
Ft. pil. No. i. Da tal. No. xx.
Sig.: Four to five pills a day (for *cardiohepatic cases*).

In general, since diuresis is soon followed by a reduction in the elimination of nitrogenous substances and chlorides, intermittent employment of a diuretic is much preferable to its continuous use.

[**Novasurol,** a brand of **merbaphen,** and chemically a double salt of sodium mercuri-o-chlorphenoxylacetate with diethylbarbituric acid, acts powerfully when given intramuscularly or intravenously in doses of 0.75 to 2 c.c. (12 to 32 minims) of the commercial 10 per cent. solution, at intervals of 3 to 7 days.—TR.]

D.—DRUGS ACTING ON THE BLOOD.

There will be described here only two substances acting selectively on **blood regeneration,** *viz.,* **arsenic,** which increases the number of cells, and **iron,** which increases the hemoglobin. Many other agents, in particular the organic remedies, the heavy metals (mercury), and manganese, are likewise promoters of blood regeneration. The first of these will be found described under *Organotherapy,* and all will be found grouped in the chapter on *Anemia.*

Again, different agents are serviceable in combating other blood disturbances. Thus, in the **hemorrhagic** processes, various substances may be used as hemostatics: **Ergotin, ferric chloride, calcium chloride, gelatin, horse serum, organic products,** etc.; these will be found considered together under *Hemorrhage.*

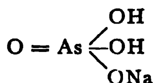
On the other hand, the *anticoagulants* and fluidifiers (sodium citrate, iodine derivatives, alkalies, etc.) may be used with advantage in many **plethoric and thrombotic conditions. Iodine** and the **alkalies** are described in the sections on *Drugs acting on the Circulation* and *on the Digestive tract.*

Lastly, brief reference will be made to **sodium citrate.**

THE ARSENICALS.

CHEMICAL CONSTITUTION.—The pharmacology of the arsenicals, which twenty years ago comprised little else than the **three inorganic compounds,** *arsenous acid, sodium arsenate* (in Pearson's solution), and *potassium arsenite* (in Fowler's solution), has since been enormously broadened through the introduction of the **organic arsenicals:** Sodium monomethylarsenate (arrhenal), sodium dimethylarsenate (sodium cacodylate), atoxyl, hectin, arsphenamin, neoarsphenamin and galyl, to mention only those in commonest use.

It is necessary to recall the progressive chemical elaboration of these compounds, starting from sodium arsenate, $As\,O_4\,H_2\,Na$:



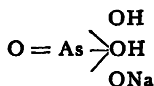
Arrhenal, or sodium monomethylarsenate, is sodium arsenate in which a hydroxyl group, OH, has been replaced by a methyl group, CH_3.

Sodium cacodylate is sodium arsenate containing two substituted methyl groups.

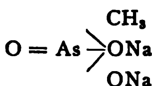
Atoxyl is sodium arsenate with a phenylamin group ($C_6H_4.NH_2$) substituted in the para position.

Hectin is benzosulphonated atoxyl.

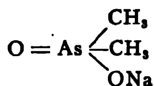
There is thus obtained the following series:



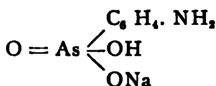
Sodium arsenate.



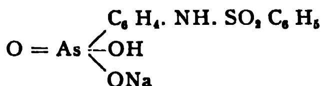
Arrhenal.



Sodium cacodylate.



Atoxyl.

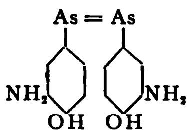


Hectin.

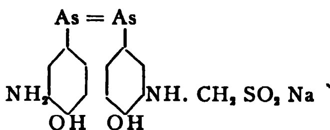
Arsphenamin, arsenobenzol, salvarsan, or 606 is a dioxydiaminoarsenobenzol.

Neoarsphenamin, novarsenobenzol, neosalvarsan, or 914, is a dioxydiaminoarsenobenzolmethylene sulphonate of sodium.

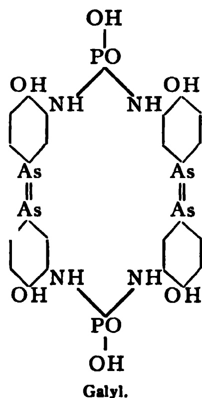
Galyl is a tetraoxy-phosphamino-diarsenobenzol.



Arsphenamin.



Neoarsphenamin.



Galyl.

PHARMACOLOGIC ACTION.—In moderate doses, arsenic is an excitant to the cellular functions. The result is a **general stimulation of the organism and of its different functions** (digestion, circulation, respiration, and nutrition), *with an especial excitation of assimilation and of oxygenation.* It is a roborant remedy of the first order and a stimulant to hematopoiesis. The drugs most commonly employed for this purpose are the inorganic arsenicals, sodium cacodylate, and arrhenal. The arsenicals are, accordingly, indicated in *anemic states* and in *impaired*

nutrition, as in tuberculosis, convalescence, cachexias, etc. Worthy of note, likewise, is the favorable action of arsenic in some cases of *asthma* and *skin disorder.*

In large doses, arsenic, in its several forms, exerts a pronounced **parasiticidal action** with reference to the *plasmodium of malaria,* the *trypanosome* (*African sleeping sickness*), relapsing fever, Vincent's angina, and the *treponema of syphilis.* The agents most generally employed for this purpose belong to the group of the *arsphenamins* (arsphenamin, neoarsphenamin, galyl). They constitute *antisyphilitic remedies, the importance of which is on a par with that of mercury.*

TOXIC ACTION.—The toxic action of the arsenical compounds may be summarized as follows: *In toxic doses, arsenic destroys the cells and impairs nutrition.* This could have been suspected already from its physiologic action.

In its acute form, this toxic action is manifested:

I. In *direct symptoms,* due to the caustic action of the arsenical preparation on the mucous membranes with which it comes in contact: Its action on the mouth and pharynx results in salivation, dryness and irritation of the throat; that on the stomach, in a burning sensation, paroxysmal gastric pain, nausea and vomiting, and that on the intestine, in cramps and diarrhea—the latter sometimes bloody and dysenteriform.

2. In *elimination symptoms:* Varying eruptions—vesicular, papular, or purpuric; salivation, and redness and swelling of the eyes.

3. In *diffusion symptoms: Hemorrhages* at various points (hemoptysis, epistaxis, melena, purpura), muscular weakness, an irregular, intermittent pulse, anuria, cyanosis, lowered temperature, and death, which supervenes usually in the midst of convulsions.

The symptoms set in twenty minutes to an hour or more after the ingestion or injection of the drug.

Death may take place in less than an hour; on the other hand, it may not occur until after the lapse of several days.

The clinical picture, recalling that of Asiatic cholera, has led to such poisoning being sometimes called "arsenical cholera."

In its chronic form, in addition to the foregoing symptoms, more or less attenuated, there are noted in particular nervous phenomena, *viz., sensory disturbances and paralysis.*

These effects generally start in the lower extremities in the form of numbness and tingling, with darting pains and slight paresthesia. Paralysis comes on later, beginning with the steppage-gait, then extending to the muscles of the antero-external region of the leg (tibi-

alis anticus, extensor proprius hallucis, and lateral peronei); finally atrophy appears. Recovery is frequent, but convalescence is sometimes very prolonged.

Note should also be made of *arsenical pigmentation* as a possible result of chronic arsenic poisoning.

The subject of the *arsphenamins* will be taken up again and more completely in the discussion of the *treatment of syphilis.*

MODES OF ADMINISTRATION.

POTASSIUM ARSENITE, in Fowler's solution, *Liquor potassii arsenitis,* made by dissolving 1 part of arsenic trioxide, 2 of potassium bicarbonate, and 3 of compound tincture of lavender in distilled water, to make 100 parts. The average dose is 0.2 c.c. (3 minims); the maximum single dose, 0.5 c.c. (8 minims or 17 drops), and the maximum daily dose, 1.5 c.c. (24 minims or 50 drops). [The "drops" are those delivered by the standard dropper authorized by the International Protocol.]

ARSENOUS ACID is official as the anhydride, *Arseni trioxidum,* the average dose of which is 0.002 gram (1/30 grain). The French Codex recognizes the so-called "granules of Dioscorides":

℞ Arseni trioxidi .... 0.1 gram (gr. iss);
Lactosi .... 4 grams (ʒj);
Acaciæ pulveris .... 1 gram (gr. xv);
Mellis .... q. s.
Ft. pil. No. c.

Each pill contains 0.001 gram (1/65 grain) of arsenic trioxide. The average daily dose is one pill per year of the patient's age [not exceeding the 20-year dose in older adults.—TR.].

SODIUM ARSENATE:

℞ Sodii arsenatis .... 0.1 gram (gr. iss);
Aquæ destillatæ .... 250 c.c. (f℥viiiss).—S.

Each teaspoonful of this solution contains about 0.002 gram (1/32 grain) of sodium arsenate. The dose is three to ten teaspoonfuls a day.

[Other preparations:

Liquor acidi arsenosi, U. S. P., 1 per cent., 0.2 c.c. (3 minims).

Liquor arseni et hydrargyri iodidi, U. S. P., Donovan's solution, 1 per cent. each of arsenous iodide and red mercuric iodide, 0.1 c.c. (1½ minims).

Arseni iodidum, U. S. P., 0.005 gram (1/12 grain)].

SODIUM CACODYLATE:

1. *Sodii cacodylas,* U. S. P., is conveniently marketed in 1 c.c. (16-minim) ampoules containing 0.05, 0.1, or 0.2 gram (¾, 1½, or 3 grains) of the salt, for *hypodermic* use.

2. *Oral administration* (not highly recommended):

℞			
Sodii cacodylatis	1 gram	(gr. xv);
Spiritus menthæ piperitæ	10 c.c.	(fʒiiss);
Spiritus jamaicensis	40 c.c.	(fʒx);
Syrupi	30 c.c.	(f℥j);
Aquæ destillatæ	60 c.c.	(f℥ij).—M.

This contains about 0.03 gram (½ grain) of sodium cacodylate per teaspoonful. The dose is one or two teaspoonfuls taken in the course of each of the heavier meals.

3. *Rectal administration:*

A 1 per cent. aqueous solution of sodium cacodylate may be used for this purpose. One or two teaspoonfuls of this in 30 c.c. (1 fluidounce) of tepid boiled water may be used as an enema. Two or three drops of laudanum may be added in the event of intolerance.

A number of recent authors, including Ravaut, Rozier, and Sicard, have advocated the use of much larger doses of sodium cacodylate, up to 0.5 gram (7½ grains) and even more in 24 hours as a tonic, parasiticide, and powerful alterative. In any case, one should reach such doses only after a cautious, gradual increase, testing out the patient's tolerance.

Doses even much larger, such as 13 grams in sixteen days, 17 grams in twenty days (Souques), 2 grams in daily injections (Rodriguez), and 6 grams intravenously (Maréchal, Nidergang), have been administered. The least that can be said is that these doses, especially the last-mentioned, are quite excessive and dangerous; that, as a matter of fact, they brought on more or less severe toxic manifestations; that one case of death was observed (San Filippo) after administration of 16.7 grams of sodium cacodylate in sixteen days in daily doses of 0.4 to 1 gram, and that, at any rate, one should carefully test the susceptibility of new cases and increase the doses only in a very methodical way. It is a fact, nevertheless, that the customary dosage of sodium cacodylate is certainly much too pusillanimous, and that there is advantage in many cases in raising the doses to such amounts as 0.4 or 0.5 gram (6 to 7½ grains).

ARRHENAL (sodium monomethylarsenate).—The same formulas and doses apply as in the case of sodium cacodylate.

HECTIN.—*Subcutaneous or intramuscular administration.*—Ampules of 1 c.c. containing 0.1 or 0.2 gram (1½ or 3 grains) of the drug are available. One or two of these are used daily or on alternate days.

ARSENICAL COMPOUNDS.

COMPOUNDS.	PHARMACEUTIC FORMS.	MAXIMUM DOSES. Single.	MAXIMUM DOSES. Daily.	PHARMACOLOGIC ACTION.	CLINICAL INDICATIONS.	CONTRA-INDICATIONS.	REMARKS.
				Inorganic.			
ARSENIC TRIOXIDE (Arsenous anhydride) (76% of arsenic).	Pills of arsenic trioxide, each containing 0.001 gram.	0.005	0.015	Nutritive tonic. Stimulant to hematopoiesis, especially cellular.	*Anemic states.* *Impaired nutrition.*	*In general, it is well to be cautious and watchful in giving arsenicals when the liver cells seem to be impaired.*	The official (Codex) maximum doses given herein are unnecessarily small. Incompatibilities: Salts of calcium and of magnesium.
SODIUM ARSENATE (24% of arsenic).	Solution or pills.	0.01	0.02	Stimulant to nutrition.	*Diathetic skin disorders.* *Some forms of asthma.*		
POTASSIUM ARSENITE (41% of arsenic).	Fowler's solution (1 per cent.)	1 gram or 33 drops (0.01 gram arsenous acid). 0.5	1.5		*Tuberculosis, as tonic.*		
				Organic.			
SODIUM MONOMETHYL-ARSENATE (Arrhenal) (27% of arsenic).	Solution. Hypodermic injections.	0.2	0.2	Same action as above. In large doses fatal to malarial plasmodia.	*Same indications.* *Malaria.*	*Do.*	
SODIUM DIMETHYL-ARSENATE (Sodium cacodylate) (46% of arsenic).	Solution. Hypodermic injecticns.	0.2	0.2	Do.	*Do.*	*In the event of fever and hemoptysis, it is often better to abstain temporarily from taking arsenicals, especially the organic compounds.*	Sodium cacodylate, especially when given by mouth, may impart an unpleasant garlic-like odor to the breath and skin.

ATOXYL (Arsenanilid).	Subcutaneous and intramuscular injections.	0.2	0.2	Parasiticide.	*African sleeping sickness.*	*Little used.*	The toxic dose is as yet imperfectly established. Solutions are unstable.
HECTIN (Benzosulphonated arsenanilid) (21% of arsenic)	Intramuscular injections.	0.4	0.4	Nutritive tonic. Hematopoietic. Antisyphilitic.	*Impaired nutrition. Anemic states. Syphilis. Malaria. Leukemias.*	*Eye and ear affections.*	Congestive reactions, especially in the sense organs.
ARSPHENAMIN (606) **Arsenobenzol** (Dioxydiamino-arsenobenzol) (34% of arsenic).	Intravenous injections. Enemas. Mixtures for external use.	0.6	0.6	Antisyphilitic. Hematopoietic. Antimalarial.	**Syphilis.** *Vincent's angina, malaria, relapsing fever, amebic dysentery. Leukemias.*	*Advanced cardio-renal insufficiency. Hepatic insufficiency.*	Now almost abandoned in favor of *neoarsphenamin.* Neoarsphenamin and galyl in intravenous injections in concentrated solutions constitute the arsenical method of choice in antisyphilitic treatment.
NEOARS-PHENAMIN (914) **Novarsenobenzol**	Intravenous injections. Enemas. Glycerin mixtures for external use.	0.9	0.9	Do.	*Do.*	*Hepatic degeneration. Cachexia.*	
GALYL. Tetraoxydiphospho-amino-diarsenobenzol (35% of arsenic).	Intravenous injections. Enemas. Intramuscular injections.	0.45	0.45	Do.	*Do.*	*Do.*	

Oral administration.—A solution of which 20 drops contains 0.05 gram (¾ grain) of hectin may be used. Twenty to 100 drops a day are given, according to tolerance.

NEOARSPHENAMIN.—Ampules containing amounts ranging from 0.15 to 0.9 gram are supplied for the *intravenous injections.*

The outfits for giving *concentrated* intravenous injections usually include a 5 or 10 c.c. ampule or solvent solution and a filter-tube required for extemporaneous preparation of the drug solution.

Neoarsphenamin possesses the immense advantage over arsphenamin of being freely soluble without the addition of sodium hydrate. It, therefore, lends itself well, without delicate manipulations, for injections in a very small volume of solution (Ravaut's method); this has markedly contributed to rendering the treatment available to all practitioners and to reducing perceptibly the frequency of untoward results.

The drug may, like hectin and galyl, be administered in an *enema,* 0.15 to 0.9 gram being given in 50 to 250 c.c. of distilled water or salt solution.

In Vincent's angina and various malignant types of ulcerations of the mucous membranes it may be applied locally, *e.g.,* in the following solution:

℞ Neoarsphenaminæ .... 0.5 gram (gr. viiss);
Aquæ destillatæ .... gtt. x-xx;
Glycerini .... 14 c.c. (f℥iiiss).
M. Sig.: For local application. (LYON AND LOISEAU.)

The *narsenol* compressed tablets (Poulenc) are none other than tablets of neoarsphenamin, with a special coating, dissolving only in the intestine, containing 0.1 gram of the drug. They are used in amebiasis, intractable parasitic enteritis, malaria, and for the other indications of neoarsphenamin. One to 4 tablets daily are given, preferably on the fasting stomach, with a little liquid.

Many other arsenobenzol derivatives, such as sulpharsenol, metarsenobenzol, amino-arsenobenzol (138), etc., have been suggested. None of them, with the exception of amino-arsenophenol (Pomaret and Jeanselme), appears to me to present really appreciable advantages over the remedies already referred to.

AMINO-ARSENOPHENOL (138, Pomaret-Jeanselme; eparseno, Poulenc) is an orange-red solution, clear and slightly syrupy. It is used pure or diluted with an equal volume of distilled water. Eparseno is supplied in ampules of 1.2 c.c. containing 0.125 gram of the active product, equivalent to 0.25 gram of neoarsphenamin, and in ampules of 1 c.c. containing 0.05 gram of the active product for pediatric use. In the adult, intramuscular injections of one ampule are given on alternate days, or injections of 2 ampules every 4 days, while in children one weekly injection of 0.005 gram per kilogram of body weight is given. Courses of 6 to 20 injections, according to age, are administered.

STOVARSOL (POULENC, preparation 190), or acetyloxyaminophenylarsinic acid, has a high arsenic content and a very low toxicity. It is given by the mouth, without serious drawbacks, and is put up in 0.25 gram tablets. It gives good results as a prophylactic, but practically no curative results in syphilis. As a preventive or in very recent contamination 3 to 4 tablets are given in the morning before breakfast for 3 days. In amebic dysentery, giardiasis, and psoriasis, 2 tablets daily are given at first, then the doses are reduced and the intervals lengthened. The drug may have certain untoward effects such as vomiting, diarrhea, fever, or edema.

TREPARSOL (formylmetaaminoparaoxyphenylarsinic acid) has been used successfully by C. Simon; it is said to have a powerful curative action on the chancre and secondary symptoms. It is used by the mouth in doses of 0.75 to 1 gram a day for 3 or 4 days in the adult. After a 3-day interval the same doses are repeated. This may be continued for 6 to 10 weeks. A nursling receives 0.05 gram a day. The possible untoward effects are diarrhea and sometimes urticaria. The drug may be tried in subjects intolerant of arsphenamins.

TRYPARSAMIDE, which has been much discussed in the United States, is the sodium salt of *n*-phenylglycinamide *p*-arsenic acid, containing, in the dry state, 25.32 per cent. of pentavalent arsenic. It has been used in the African sleeping sickness, syphilis, and, in particular, in general paralysis, intravenous injections of 3-gram doses being given weekly. The brilliant results announced in America have not been confirmed in France. In any event, this drug may be dangerous for the optic nerve.

ARSYLENE (propenylarsinic acid), of low toxicity, can be substituted for sodium cacodylate, from the disadvantages of which it is said to be free, even in large doses (no dryness of the throat and mouth, no garlic odor of the breath, no digestive or nervous disturbances, no skin manifestations, no congestive flushes, no fever, etc.). It is employed either in massive doses (ampules of 2 c.c. containing 0.2 gram) = 0.2 to 0.6 gram a day, for example, in nervous and mental affections (chorea, disseminated sclerosis, contractures, sequelæ of encephalitis, melancholia, hypochondria, neurasthenia, etc.), in skin diseases, parasitic affections, Vincent's angina, etc.; or, in small doses (ampules of 1 c.c. containing 0.05 gram) in the anemias, asthenia, etc. = 0.05 to 0.1 gram every 24 hours, hypodermically or by mouth (granules of 0.01 gram).

GALYL.—This is given *intravenously* from ampules of 0.1 to 0.35 gram. The technic of the injections is in all respects similar to that which obtains in the case of neoarsphenamin.

ARSENIC COMBINATIONS.

1. ARSENIC AND IODIDES:

℞ Sodii arsenatis	0.1	gram	(gr. iss);
Sodii iodidi	10	grams	(ʒiiss);
Fluidextracti aurantii amari	24	c.c.	(fʒvj);
Syrupi q. s. ad	240	c.c.	(f℥viij).

M. Sig.: One dessertspoonful with each meal.

This prescription will last for ten days, the patient getting each day approximately 0.01 gram (1/6 grain) of sodium arsenate and 1 gram (15 grains) of the iodide. The combination is frequently of value in conditions of impaired nutrition in individuals of the lymphatic type.

2. ARSENIC, IODIDE AND BROMIDE:

℞ Sodii arsenatis	0.1	gram	(gr. iss);
Sodii iodidi	10	grams	(ʒiiss);
Sodii bromidi	15	grams	(℥ss);
Fluidextracti aurantii amari	24	c.c.	(fʒvj);
Syrupi q. s. ad	240	c.c.	(f℥viij).

M. Sig.: One dessertspoonful three times daily with the meals.

The patient thus receives each day approximately 0.01 gram (1/6 grain) of sodium arsenate, 1 gram (15 grains) of the iodide, and 1.5 grams (22½ grains) of the bromide. The combination is serviceable in lymphatic states with nervous excitement.

3. ARSENIC AND IRON (see *Iron*).

4. ARSENIC AND MERCURY (see *Mercury*).

5. TONIC COMBINATIONS WITH STRYCHNINE, GLYCEROPHOSPHATES, CINCHONA AND KOLA.

(*a*) I frequently prescribe the following combination in any of the conditions of general depression with poor nutrition (depressive psychoneuroses, convalescence after infections, grippe, pulmonary tuberculosis):

℞ Strychninæ sulphatis	0.03-0.06	gram	(gr. ½-j);
Sodii arsenatis	0.1	gram	(gr. iss);
Sodii glycerophosphatis	10	grams	(ʒiiss);
Extracti cinchonæ	20	grams	(ʒv);
Spiritus vini vitis	60	c.c.	(f℥ij);
Glycerini q. s. ad	150	c.c.	(f℥v).

M. Sig.: One teaspoonful in a little coffee or other beverage before meals.

(*b*) Various preparations on the market for hypodermic use contain similar combinations. Following is a typical formula:

℞ Strychninæ sulphatis	0.06	gram	(gr. j);
Sodii cacodylatis	1	gram	(gr. xv);
Aquæ destillatæ q. s. ad	100	c.c.	(f℥iii⅓).

To be tyndallized three times at 100° C. Dose: 2 to 10 c.c. (½ to 2½ fluidrams) a day, containing 0.001 to 0.006 gram (1/65 to 1/10 grain) of strychnine and 0.02 to 0.1 gram (⅓ to 1½ grains) of sodium cacodylate.

(*c*) Sometimes solutions of strychnine and sodium cacodylate are prescribed, and even at times the term "strychnine cacodylate" is used. *These*

two compounds are incompatible and yield an abundant precipitate in the autoclave.

Every one will doubtless have occasion to formulate many variations of the foregoing drug combinations.

Arsenical Mineral Waters.—The waters of *La Bourboule,* France, possess a high arsenical content. The *Choussy* spring, for example, contains in each liter an amount of arsenic corresponding to 0.028 gram of sodium arsenate.

The waters of *Le Mont-Dore* contain a much smaller amount, corresponding to 0.0014 gram to the liter.

The altitude of these resorts, in conjunction with the mineral content and high temperature of the waters, produces tonic and reconstituent effects.

The Saint-Cézaire spring at *Saint-Nectaire,* the Saint-Victor at *Royat,* the Deval at *Châtel-Guyon,* the Hôpital at *Vichy,* and *Bussang* also contain appreciable amounts of arsenic.

[For the arsenical springs in countries other than France see the section on *Crenotherapy,* this Volume].

IRON.

Whatever opinion be entertained regarding the mode of action of the iron compounds—a question still open to discussion and widely discussed—**the regenerating, up-building, and blood-building, or better, hemoglobin-building effect of iron is firmly established.**

Indeed, the solutions of iron salts exhibit such striking properties as regards coloration, affinity for oxygen, and sensitiveness to the reaction of the solvent medium, that one might conceive of a theory of the physiologic combination of oxygen with the hemoglobin on this basis. This theory would be founded on the fact that the stability of the peroxide metalloxidases is strongly influenced by the carbon dioxide concentration in the solvent fluid. The implications of this observation are obvious.

Clinically, **a well-chosen and properly administered iron preparation acts after the manner of a specific in certain anemias.**

The iron preparations are indicated, indeed, in all the anemias, primary or secondary, essential or symptomatic (anemias, chlorosis, hemolytic icterus, post-infectious anemias, lymphatism, sluggish tuberculosis, etc.).

MODES OF ADMINISTRATION:

Following are some examples of convenient methods of administering iron:

INSOLUBLE INORGANIC PREPARATIONS.—A laxative, such as aloe, rhubarb, or cascara, should be combined with these:

(a) ℞ Ferri subcarbonatis,
Rhei pulveris ....āā 0.1 gram (gr. iss).
Ft. pil. No. i. Da tal. No. xxxvi.
Sig.: Two to five pills a day.

(b) ℞ Ferri protoxalatis,
Extracti cascaræ sagradæ ....āā 0.1 gram (gr. iss).
Ft. pil. vel cachet. No. i. Da tal. No. xxxvi.
Sig.: Two to five pills a day.

[*Ferri carbonas saccharatus,* U. S. P., 0.25 gram (4 grains).
Massa ferri carbonatis, U. S. P., 0.25 gram (4 grains).
Pilulæ ferri carbonatis, U. S. P., 2 pills.
Ferrum reductum, U. S. P., 0.06 gram (1 grain).]

SOLUBLE INORGANIC PREPARATIONS:

(a) ℞ Ferri protochloridi .... 0.1 gram (gr. iss);
Frangulæ pulveris (N. F.),
Glycyrrhizæ pulveris ....āā 0.05 gram (gr. ¾).
Ft. pil. No. i. Da tal. No. xxxvi.
Sig.: Two to six pills a day.

(b) ℞ Ferri chloridi .... 10 c.c. (f℥iiss);
Spiritus ætheris (N. F.) .... 70 c.c. (f℥xviiss).
M. Sig.: One or two teaspoonfuls a day in lemonade, or orangeade, or syrup.

(c) Protiodide of iron. A syrup containing 0.1 gram (1½ grains) per tablespoonful may be used. Dose: Two to four tablespoonfuls a day.

[*Ferri phosphas solubilis,* U. S. P., 0.25 gram (4 grains).
Ferri sulphas, U. S. P., 0.1 gram (1½ grains).]

ORGANIC PREPARATIONS:

(a) ℞ Ferri lactatis (N. F.) .... 0.1 gram (gr. iss);
Extracti euonymi (N. F.) .... 0.05 gram (gr. ¾);
Extracti gentianæ (N. F.) .... q. s.
Ft. pil. No. i. Da tal. No. xl.
Sig.: Four pills a day.

(b) Cacodylate of iron. Obtainable in ampules containing 0.05 gram (¾ grain) in each c.c. Dose: 1 to 5 c.c. (16 to 80 minims) a day.

(c) Syrup of hemoglobin, 5 per cent. Two to five tablespoonfuls a day.

[*Ferri et ammonii citras,* U. S. P., 0.25 gram (4 grains).
Ferri citras. U. S. P. VIII, 0.25 gram (4 grains).
Ferri lactas, N. F., 0.3 gram (5 grains).
Liquor ferri albuminati, N. F., 8 c.c. (2 fluidrams).
Liquor ferri peptonati, N. F., 8 c.c. (2 fluidrams).]

COLLOIDAL PREPARATIONS.—Colloidal iron, electrically prepared, is on the market. The preparation is given in doses of 10 c.c. (2½ fluidrams) a day by subcutaneous, intramuscular, or intravenous injection.

[*Liquor ferri oxychloridi*, N. F. IV, is a colloidal solution of ferric hydroxide in ferric chloride, and is but mildly astringent. Dose: 2 c.c. (½ fluidram).

Liquor ferri dialysatus, unofficial (dialysed iron), is a preparation similar to the preceding from which the excess of acid and chloride has been dialysed out; it is still less astringent. Dose: 2 c.c. (½ fluidram)].

AVERAGE IRON CONTENT OF FOODS.—The figures in the following table refer to milligrams per 100 grams of the food in the fresh condition:

Food	mg	Food	mg
Spinach	40	Fish	7
Butcher's meat	37	Peas	7
Green cabbage	30	Potato	6
Chicory	22	Barley	5
Yolk of egg	19	Rice	4
Lentils	9	Cow's milk	2
Carrots	9	Whole wheat bread	2
White beans	8	White bread	1

IRON MINERAL WATERS.—These may be roughly divided into three groups:

1. The *bicarbonate waters*, acting on the digestive tract and building up the system, indicated especially in the *chlorotic anemias* and in *dyspepsias* with *poor nutrition:* Bussang, Orezza, Reinlaigue, Spa, Pyrmont, Saint-Moritz, and Lamalou.

2. The *sulphate waters*, aperient, styptic, tonic, hemostatic, and sedative, which contract the capillaries and in a measure diminish heat-production; they are especially suitable in *purpura, visceral atony, cachexias*, etc.: Saint-Christau, Auteuil, Passy.

3. The *crenate waters*, actual oxidases or transporters of oxygen, which accelerate the oxidation processes and simultaneously play a marked hematogenous rôle; they are particularly suitable in the *chlorosis of puberty*. They are represented by the waters of Forges.

[See also the section on *Crenotherapy*, this Volume.]

IRON COMBINATIONS.

1. ARSENIC AND IRON:

Arsenic, stimulating blood-cell formation, and iron, enhancing hemoglobin production, exert extremely valuable synergistic effects in the majority of anemic states.

(*a*) *Alternate use of an arsenical and an iron preparation.*

IRON COMPOUNDS.

COMPOUNDS.	PHARMACEUTIC FORMS.	CUSTOMARY DOSES. Single.	CUSTOMARY DOSES. Daily.	PHARMACOLOGIC ACTION.	CLINICAL INDICATIONS.	CONTRA-INDICATIONS.	REMARKS.
Insoluble.							
IRON SUBCARBONATE.	Pills. Cachets. *Pilulæ ferri carbonatis*, containing 0.1 gram.	0.1 to 0.2	1 to 4	Stimulant to hemoglobin formation.	*Anemia. Hemolysis.*	be avoided in active cases of tuberculosis with to hemoptysis, impaired nutrition, etc.	These preparations being astringent, it is well to combine with them a laxative, such as aloes, rhubarb, or cascara.
IRON PROTOXALATE.	Pills. Cachets.	0.1 to 0.2	1 to 4	Do.	*Hemolytic jaundice.*		
Soluble.							
FERRIC CHLORIDE.	Drops or solution, *e.g.*, in ether spirit.	0.1 to 0.5	1 to 4	Stimulant to hemoglobin formation.	—		When harm to the teeth is feared, it may be wise to recommend the taking of the soluble iron compounds in liquid form through a glass tube.
FERROUS CHLORIDE.	Pills. Cachets.	According to tolerance.		—	—		
FERROUS IODIDE.	*Pilulæ ferri iodidi*, N. F., containing 0.05 gram. *Syrupus ferri iodidi* (5 per cent. FeI_2).	0.1 to 0.5	1 to 4	Stimulant to hemoglobin formation. Antiscrofulous action.	*Anemias. Scrofula. Lymphatism. Torpid tuberculosis.*		

FERRIC PHOSPHATE.	Pills. Solution.	Do.	Do.	—	—	In a general way, the iron preparations should fever, congestive exacerbations, tendency	
FERROUS SULPHATE.	Pills.	0.05 to 0.3		—	—		Rather strongly astringent.
FERROUS LACTATE.	Pills. Cachets.	0.1 to 0.5	Do.	—	—		
FERRIC GLYCERO-PHOSPHATE.	Pills. Cachets.	Do.	Do.	—	—		
FERRIC CACODYLATE.	Pills. Cachets. Hypodermic injections.	0.1	0.2	—	—		Injections sometimes painful and rather poorly borne.
FERRIC PEPTONATE.	Drops. Elixirs.	0.1 to 0.5	1 to 4	—	—		A useful preparation.
HEMOGLOBIN.	Syrup. Elixirs. Confections.	2	10	—	*Particularly serviceable in anemias accompanied by dyspepsia. Torpid tuberculosis.*		A useful preparation.
COLLOIDAL IRON (electrically prepared).	Injections: subcutaneous; intramuscular; intravenous.	2 c.c.	10 c.c.	—	*Anemias. Hemolysis. Hemolytic jaundice.*		

Examples: Arsenic trioxide pills and peptonate of iron in alternation; injections of sodium cacodylate and preparations of hemoglobin in alternation, etc.

[(*b*) A clear, colorless combination of Fowler's solution and ferric chloride can be obtained by first mixing the Fowler's solution with several times its volume of dilute phosphoric acid, then adding the tincture of iron and lastly some water. A "shake" label should be ordered].

(*c*) Cacodylate of iron, obtainable in ampules containing 0.05 gram (¾ grain) of the salt per c.c. Dose: 1 to 4 c.c. (16 to 64 minims) a day by hypodermic injection.

2. Tonic Iron Combinations:

With cinchona, glycerophosphates, strychnine, etc.:

℞ Strychninæ sulphatis .... 0.001 gram (gr. 1/65);
Sodii arsenatis .... 0.002 gram (gr. 1/32);
Ferri protoxalatis,
Quininæ dihydrochloridi,
Calcii glycerophosphatis,
Extracti rhei ....āā 0.05 gram (gr. ¾);
Glycerini .... q. s.
Ft. pil. No. i.

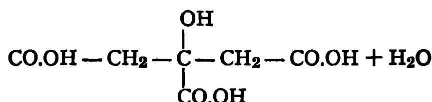
The extract of rhubarb, acting as corrective and laxative, and practically indispensable in iron pills, might, of course, be replaced by aloes, cascara, euonymus, etc.

℞ Syrupi ferri iodidi,
Syrupi calcii lactophosphatis (N. F.),
Syrupi cinchonæ (10 per cent.) ....āā 30 c.c. (f℥j);
Glycerini .... q.s.
M. Sig.: One dessertspoonful in the middle of each meal.

INCOMPATIBILITIES OF IRON.—In conclusion, it will be well to recall the *chemical incompatibility existing between iron salts in solution* and tannin or substances containing it (cinchona, gambir), as well as the alkalies and their carbonates; these must not be brought together with iron solutions, which they precipitate. This reaction is practically *nil* in syrups, however—hence our description of such a combination above—and again, Patein has shown that the incompatibility of iron salts with the tannin in cinchona can be prevented in the following way: Citrate of iron and the extract of cinchona yield a precipitate of iron tannate which disappears upon addition of a little glycerin.

SODIUM CITRATE, $Na_3C_6H_5O_7 + H_2O$.

This is the sodium derivative of citric acid:



which occurs in various fruits, particularly the lemon, the antiscorbutic properties of which have been empirically recognized from time immemorial. The official syrup of citric acid—*Syrupus acidi citrici,* U. S. P.—contains 1 per cent. each of citric acid and of tincture of lemon peel.

Sodium citrate is an anticoagulant of the first rank; blood collected in a receptacle containing sodium citrate fails to coagulate. This property forms the basis of a modern procedure for blood transfusion, which has thereby been rendered available to all practitioners (see *Transfusion*).

It may be prescribed in many plethoric conditions with high blood viscosity and rapid coagulation, in phlebitis, and in thrombotic manifestations. Its use can be recommended in *acute lobar pneumonia.* Its action in opposing high viscosity lowers the tendency to hepatization. It has, in fact, given favorable results. Citric lemonade has long been used in hospitals in this condition.

Systematic use of sodium citrate in an average dose of 3 or 4 grams (45 to 60 grains), either by the mouth or in intravenous injections, has given encouraging results in a number of cases of *arteritis obliterans* (Ozzo de Saint-Nazaire, Moricheau-Beauchamp); it is used as a digestive stimulant and to favor the digestion of milk, the coagulability of which it reduces. It has a slight purgative property.

Citric acid is given in the form of syrup of citric acid, in *citric lemonade* (1:1000), or in a flavored solution:

℞	Acidi citrici	10 grams	(ʒiiss);
	Syrupi cerasi	50 c.c.	(f℥iss);
	Aquæ	250 c.c.	(f℥viij).—M.

One tablespoonful contains 0.5 gram (7½ grains) of citric acid. The dose is eight to twelve tablespoonfuls a day.

Sodium citrate is prescribed in a solution by mouth or by intravenous injection:

(*a*) ℞	Sodii citratis	20 grams	(ʒv);
	Aquæ destillatæ	300 c.c.	(f℥x).

One tablespoonful contains 1 gram (15 grains) of sodium citrate. The dose is two to ten tablespoonfuls a day.

(*b*) ℞ Sodii citratis .... 20 grams (ʒv);
Syrupi acidi citrici .... 100 c.c. (f℥iiiss);
Aquæ .... 200 c.c. (f℥vij).

One tablespoonful contains 1 gram (15 grains) of sodium citrate and 0.05 gram (¾ grain) of citric acid.

(*c*) A sterilized 0.5 per cent. solution of sodium citrate may be used for intravenous injections. The patient's sensitiveness to the drug should be carefully tested by small preliminary injections, as somewhat alarming effects have been observed in some individuals.

II

DRUGS ACTING ON THE URINARY TRACT.

The drugs acting selectively on the urinary functions comprise, in a general way:

The **diuretics.** These have already been described in conjunction with the circulatory remedies, because at the present time it is practically impossible accurately to differentiate from the pharmacodynamic standpoint the cardiovascular diuretic agents from the purely renal agents.

The **uricolytics.** These may be more appropriately described, it would seem, in the chapter upon the agents acting selectively on nutritive metabolism.

The **organotherapeutic renal remedies.** These will be mentioned in the chapter on organotherapy.

This section would, therefore, have been reduced to practically nothing had not Dr. Saint-Cène kindly consented to prepare a short summary of the drugs commonly used in urologic practice, comprising:

The **urinary antiseptics**: *Internal:* type drug, hexamethylenamin, and *external:* type drug, potassium permanganate.

The **balsams,** typified by santal oil.

The **anesthetics,** typified by cocaine.

The **external hemostatics,** typified by antipyrin and adrenalin.

COMMONLY USED DRUGS RELATING TO THE URINARY TRACT.

(*Written with the collaboration of Dr. SAINT-CÈNE.*)

THE URINARY ANTISEPTICS.

INTERNAL ANTISEPTICS.

METHENAMIN or *hexamethylenetetramin,* also known as *urotropin, formin, uroformin,* etc., is a combination of formaldehyde with ammonia. It is at present the best and most frequently used of the urinary antiseptics. Many are the proprietaries containing it; in some it is combined with diuretics, in others with stone-solvents, and in still others with the balsams.

Methenamin occurs in the form of colorless crystals, soluble in water, and with a slightly bitter taste.

The drug is highly diffusible, and is eliminated readily through the urinary tract; yet it can be observed that elimination goes on also through the liver and with the saliva, and the drug may be found in the blood and the cerebrospinal fluid. Hence the numerous indications of methenamin other than those relating to disorders of the urinary tract.

Modes of Administration and Dose.—The drug may be given in *tablets* or *cachets,* taken with a suitable amount of water, or better, in a *solution* in combination with sodium benzoate and balsamic syrups.

The subjoined formula appears to the writer to answer the majority of the indications:

℞ Methenaminæ,
Sodii benzoatis ....āā 5 to 10 grams (gr. lxxv-cl);
Syrupi terebinthinæ,
Syrupi buchu ....āā 75 c.c. (f℥iiss).
M. Sig.: One to three tablespoonfuls a day.

The average daily dose is 1.5 to 3 grams (22½ to 45 grains). In some cases, however, the dose can be increased without difficulty.

Methenamin may also be administered by ***intramuscular,*** or better, by ***intravenous injection*** in amounts of 1.5 or 2 grains (22½ or 30

grains) in 5 c.c. (80 minims) of water. This plan of administration is mainly adapted for septicemic cases.

Two kinds of **untoward effects** are possible in the use of this drug:

Gastric Disturbances.—Pain, cramps, burning sensation, and vomiting, coming on at once; these can be avoided by prescribing the drug in a dilute solution.

Renal Disturbances.—Pains in the lumbar regions and bladder, dysuria, and hematuria following the ingestion of large doses, such as 6 to 8 grams (90 to 120 grains), which, as a matter of fact, are as a rule unnecessarily large and useless.

Methenamin, by reason of its efficacy in certain cases of bacteriuria and superficial pyuria, has become a currently employed remedy which is, perhaps, really abused of. There is no doubt that its reckless administration is often harmful in cystitis, especially in the acute form, where its prolonged use sometimes leads to aggravation of the pain.

HELMITOL is a combination of methenamin with methylene-citric acid. The two components are split apart in the system and the action of the methylene-citric acid is claimed to be superadded to that of the methenamin. Helmitol is a strongly acting urinary antiseptic, and is held also to favor the dissolution of calculi. It is prescribed in doses of 3 to 4 grams (45 to 60 grains) a day.

PHENYL SALICYLATE or *salol* acts on the urine after being decomposed in the bowel into salicylic acid and phenol. Salicylic acid is found in the urine 1½ to 2 hours after ingestion of the drug, and its elimination is believed to continue for 24 to 48 hours, according to the dose taken.

The customary dose is 2 to 4 grams (30 to 60 grains) a day, given in divided amounts of 0.25 to 0.5 gram (4 to 8 grains)—conveniently in capsules or cachets.

In patients with diseased kidneys it should be used only with caution.

BORIC ACID has been used internally for the purpose of overcoming alkalinity of the urine.

Its use has been recommended in *nocturnal enuresis in children.* It may be prescribed in solution in doses of 1 to 3 grams (15 to 45 grains) a day.

BENZOIC ACID, derived from benzoin, and the *benzoates,* have the property of keeping the urine acid; this may assist in combating ammoniacal fermentation. Benzoic acid is employed in doses of 0.2 to 1.5 gram (2 to 23 grains) in liquid preparations or in pill form; sodium benzoate is given in the same dose.

CAMPHORIC ACID is a good urinary antiseptic, active and well tolerated, much used in America. Dose, 1 to 3 grams (15 to 45 grains) a day in cachets; it is combined with methenamin under the name *amphotropin.*

EXTERNAL ANTISEPTICS.

POTASSIUM PERMANGANATE ($KMnO_4$) occurs in the form of shining prismatic needles. It is freely soluble in hot water, dissolves somewhat more slowly in cold water, and is a good antiseptic, powerfully antagonistic to the gonococcus.

It is employed in 1:20,000 or 1:10,000 solutions (see *Gonorrhea*).

MERCURY OXYCYANIDE is considerably used in urinary therapeutics. It is employed in 1:5000 to 1:1000 solutions. It is well to color its solutions with minute amounts of eosin or picric acid.

Mercury oxycyanide solutions of 1:4000 or 1:2000 strength are indicated in chronic urethritis, especially the non-gonococcic cases. It is very suitable as an antiseptic for ordinary use in filling the bladder previous to cystoscopy, in a 1:4000 solution, and likewise for the preservation of urologic suture material in antiseptic solution, in view of the fact that it produces no harmful effect on instruments. *In cases under iodide treatment the oxycyanide should not be used, as the elimination of iodine in the urine gives rise in the bladder to the production of the strongly caustic mercuric iodide, and sharp pain may result.*

MERCURY BICHLORIDE is used in instillations in the treatment of tuberculosis of the bladder. A solution of 1:8000 strength, free of alcohol and of tartaric acid, should be prescribed.

ACRIFLAVIN, *flavin,* or *gonacrin* occurs as a fine, reddish brown powder somewhat similar to eosin in appearance and affording solutions of a handsome yellow color. Acriflavin has been extensively used of late in America in the treatment of gonorrhea and chronic forms of urethritis.

There is an increasing tendency on the part of the Americans to replace this product by **mercurochrome-220 soluble** (Young), a disodium salt of dibromoxide mercurifluorescein. It contains 23 to 24 per cent. of mercury in organic combination. Its germicidal and antigonococcal action is very powerful, and the Americans commend it highly.

The above 2 products are used in 1:4000 to 1:1000 solutions. They have great diffusive power and their desiccant action on the mucosa is unmistakable.

The great disadvantage of these preparations is their staining property and the difficulty of removing the stains they produce.

GOMENOL, or oil of niaouli, is obtained from *Melaleuca leucodendron*, of the natural order Myrtaceæ, growing in Tahiti. It is a good urinary antiseptic and at the same time enjoys sedative and anesthetic properties. It is used in an oily solution of 5 to 20 per cent. strength for bladder instillations.

VIOFORM is an antiseptic powder which may be used in an oily suspension in the form of *vioform oil* (vioform in suspension in oil of sesame).

It is a good remedy for allaying the pain in some cases of cystitis, particularly in tuberculosis of the bladder. In this connection it seems to act in a manner similar to bismuth on the gastric mucosa, and forms a species of protective coat over the mucous membrane.

SILVER SALTS.

The salts of silver are very extensively employed in urologic practice.

SILVER NITRATE is the one longest in use, and remains one of the principal remedies in our therapeutic arsenal. Silver nitrate occurs in colorless crystals which turn white on exposure to light. Solutions of this salt should be prepared with distilled water in order to obviate precipitation of the silver by the chlorides, and should be kept protected from the light, in a blue or yellow glass bottle. Silver nitrate solutions of 1 : 100,000 to 1 : 10,000 strength are employed for bladder irrigation. It is the ideal external urinary antiseptic in all severe infections of the urinary tract, and in febrile conditions, especially in prostatic and calculous cases, provided the cystitic lesions are not too pronounced. Silver nitrate is, accordingly, contraindicated in tuberculous cystitis.

Solutions of 1 : 100 to 1 : 1000 strength are employed for washing out the renal pelvis in cases of pyeloureteral suppuration.

In the urethra, silver nitrate is used in 1 : 200 to 1 : 50 instillations.

ARGYROL is an organic combination of silver, and is one of the most active and most extensively used products of this nature. It is of American origin, having been discovered by Barnes, of Philadelphia, in 1902.

Argyrol contains 30 per cent. of silver. It is at the present time, with phytol, the remedy of choice in the treatment of gonorrhea in its early stage or for abortive purposes. It is used in 20 to 25 per cent.

strength for intra-urethral injections. For the manner of application of argyrol the reader is referred to the section on the treatment of *Gonorrhea*.

[*Argento-proteinum mite*, U. S. P., mild silver-protein or mild protargin.]

PHYTOL is a French product closely similar to argyrol. It regularly contains 30 per cent. of metallic silver. The addition of a small quantity of copper sulphate increases its antiseptic action. It is of great value as an antigonococcic. It is employed in freshly prepared concentrated solutions of 5 to 20 per cent. strength (see *Gonorrhea*). Phytol is absolutely non-caustic; as much cannot be said of imitations of argyrol marketed under the name of "silver vitellinate."

PROTARGOL, or silver proteinate, is an albuminate of silver containing 8.3 per cent. of the metal. It has been strongly recommended by German authors, and according to them (Neisser, Friedländer), is superior to all other drugs as an antigonococcic agent.

It is used in solutions of 1 : 2000 to 1 : 1000 strength for irrigations and in 1 to 5 per cent. solutions for instillations.

[*Argento-proteinum forte*, U. S. P., strong silver-protein or strong protargin.]

SYRGOL, an organic silver preparation containing 20.26 per cent. of colloidal silver, is used in 1 : 2000 to 1 : 1000 solutions for copious urethral irrigations and in a 1 per cent. solution for urethral instillations. It is a good substitute for protargol and has approximately the same indications.

There are very many other silver preparations, for the most part little used in France. All, however, have been more or less extolled and possess notable antigonococcic properties. Among the best known of these may be mentioned *argentamin* (in 1 : 1000 to 1 : 500 solution); *argonin* (Lewin and Jadassohn), containing 4 per cent. of silver and used for irrigations in 1 : 2000 to 1 : 1000 strength, or for urethral instillation; *largin* (1 : 400 to 1 : 100), and *septacrol Ciba* (1 : 2000 to 1 : 500).

There have been recommended certain combinations of silver and of bile salts under the name of *choleval*, much used in Germany, and of *felargent*, prepared in France by the Usines du Rhône.

FELARGENT, a good antigonococcic, contains 2 to 5 per cent. of colloidal silver.

Lately, in Czecho-Slovakia, Wiechowski and Klausner brought out under the name of *reargon* a combination of certain vegetable

glucosides and of silver. This product is used in freshly 5 to 10 per cent. prepared solutions for urethral injections. The injection of it is absolutely painless and its antigonococcic action, which we have verified, is quite remarkable.

A general remark applies to all the silver compounds just mentioned, viz., that the solutions must always be freshly prepared in the cold, with cold sterilized distilled water.

* * *

IODARGOL is a preparation of colloidal iodine standardized to 0.25 gram of colloidal iodine per cubic centimeter.

It is both highly diffusible and very readily absorbed, and possesses *lymphagogue* properties (marked blood transudation in the area where applied, without hyperemia; also liquefaction of exudates) as well as *antiseptic, phagocytic, analgesic* and *cicatrizing* properties.

In acute urethritis, according to Deschamps and Perrigault, it considerably shortens the course of the disease. It has been used by the writer mainly in *chronic urethritis,* either by instillations or for intra-urethral treatments by the method of Motz. It has seemed to give good, though inconstant, results.

BALSAMS.

The balsams in general possess the property of being eliminated in part by the glands of the urinary tract, and thus serve to render abnormal secretions more fluid and reduce their amount.

The use of these substances directly in the acute period of gonorrhea does not seem wise. According to the precepts of Fournier, one may resort to their use toward the close of the acute stage, when the discharge is beginning to show a distinct spontaneous reduction.

Those most commonly employed are:

1. **OIL OF SANTAL,** from *Santalum album* (Santalaceæ), which is a light yellow oil obtained from sandalwood by distillation. It is prescribed in doses of 1 to 10 c.c. (16 to 160 minims) a day in capsules of 0.25 to 0.5 c.c. (4 to 8 minims) each.

2. **SANTALOL** [$C_{15}H_{26}O$] is the active principle of oil of santal, and is given in capsules of 0.25 c.c. (4 minims) each up to 1 or 2 c.c. (16 or 32 minims) a day.

3. **COPAIBA,** known since two centuries, is a resin which flows from incisions made into the trunk of several trees of the genus *Copaifera* (South America).

It occurs as a thick, viscid, slightly brownish fluid, soluble in alcohol and ether and containing 30 to 50 per cent. of an essential oil isomeric with oil of turpentine, and 25 to 30 per cent. of copaivic acid, a crystalline resin with which bases combine to form salts (sodium copaivate Raquin).

Copaiba is eliminated with the urine, to which it imparts a characteristic and tell-tale odor. According to Ricord, urine impregnated with this drug produces a favorable effect on gonorrheal secretions, whence the instruction given to the patient who is to be subjected to copaiba treatment to drink water in moderation, and the prescription of the drug in small, repeated doses.

The amount generally prescribed is 6 to 12 c.c. (1½ to 3 fluidrams) a day in capsules.

Copaiba is not free from possible unpleasant effects. It may cause digestive disturbances or certain troublesome eruptions (copaibic roseola, purpura or erythema).

The celebrated Chopart's mixture is now practically abandoned. Sometimes copaiba is combined with cubebs in a paste of the following composition:

℞ Copaibæ .... 30 grams (f℥j);
Cubebæ .... 40 grams (ʒx);
Gambir pulveris .... 5 grams (gr. lxxv);
Olei menthæ piperitæ,
Olei cinnamomi .... āā gtt. v.

To be taken in boluses in unleavened bread; 6 to 8 daily. Each bolus is of hazelnut size.

4. **CUBEBS**, just referred to, is seldom given alone. Its antigonorrheal action is less distinct than that of copaiba, but on the other hand, it is less apt to cause unpleasant by-effects. Combined with copaiba in the foregoing prescription, it is claimed to increase the specific action of the copaiba.

5. **KAVA-KAVA** is a liquid extract obtained from the root of a plant indigenous to the islands of the Pacific, *Piper methysticum*. It is both diuretic and antigonorrheal, and in addition exerts an anesthetic action on the mucous membrane. It is claimed to be particularly indicated for allaying the inflammatory erethism and pain of acute gonorrhea and of cystitis.

It is prescribed in doses of 20 to 30 drops three or four times a day in capsules or in a liquid preparation:

℞ Fluidextracti kavæ (N. F.) .... 24 c.c. (fʒvj);
Glycerini,
Syrupi menthæ piperitæ .... āā 30 c.c. (f℥j).

M. Sig.: One teaspoonful after each meal.

6. **BUCHU,** or *Barosma crenulata* (*Rutaceæ*), is a plant indigenous to South Africa the leaves of which contain an essential oil exerting a favorable influence on the mucous membranes of the urinary tract.

It is used in the form of the fluidextract, of which 2 or 3 c.c. (32 or 48 minims) may be given daily:

℞ Fluidextracti buchu .... 4 to 8 c.c. (f℥i-ij);
Alcoholis,
Glycerini .... āā 10 c.c. (f℥iiss);
Syrupi benzoini, tolu, vel terebinthinæ (10%) 30 c.c. (f℥j);
Aquæ .... q. s. ad 125 c.c. (f℥iv).
M. Sig.: Two or three tablespoonfuls a day.

Or in pills:

℞ Extracti buchu aquosi,
Terebinthinæ laricis (N. F. IV) .... āā 0.1 gram (gr. iss);
Magnesiæ .... q. s.
Ft. pil. No. i. Da tal. No. i.
Sig.: Six to ten pills a day.

7. **TURPENTINE,** consisting either of the Venice or larch turpentine, extracted from *Larix europæa,* or the Bordeaux turpentine, extracted from the maritime pine, *Pinus pinaster.* is a balsamic substance frequently prescribed for the relief of pain in cystitis (in keratin-coated pills or in syrup).

ANESTHETICS.

In urologic practice several types of local anesthesia are employed.

1. **For examination of the urethral canal,** in sensitive patients or in nervous individuals subject to spasm, it is well to give a preliminary *injection of 1 per cent. cocaine solution* or of 2 per cent. stovaine solution before introducing instruments (sounds, prostatic catheter, cystoscope, etc.).

The best plan of administration is direct injection of the solution into the canal by means of Bonneau's plungerless syringe (plungerless syringe with Janet nozzle). The solution injected should be kept in contact with the mucous membrane for a few minutes by closing the meatus with the fingers.

The use of cocaine as a preliminary injection is also of assistance in the diagnosis of urethral spasm, too often mistaken for a stricture. In urethro-vesical irrigation without a catheter, the cocaine injected into the canal will facilitate passage of the fluid into the bladder in nervous subjects.

2. **For examination of the bladder** (cystoscopy, ureteral catheterization, fulguration) and, in a general way, for all endovesical procedures, *cocaine* or *stovaine in 1 or 2 per cent. solution* may be used. Some sur-

geons use even stronger solutions. Before and after the lavage of the bladder, 50 to 100 c.c. (1⅔ to 3⅓ fluidounces) of the anesthetic solution should be introduced.

Procaine (novocaine) in 1 or 2 per cent. solution, with or without 5 or 10 drops of adrenalin per 100 c.c., might be advantageously substituted for the cocaine.

In some cases of difficult ureteral catheterization, one might use in addition an enema containing antipyrin and laudanum, and a hypodermic injection of morphine. General anesthesia is sometimes necessary.

3. **General anesthesia with ether or chloroform,** still employed in the majority of urological operations, is often contraindicated by the precarious state of health of the patients with urinary disorders, and there is an increasing tendency to resort to the various procedures of local anesthesia.

4. **Local anesthesia** by infiltration with the aid of procaine (novocaine) in 1 per cent. solution with the addition of 1 to 10 drops of adrenalin has numerous applications in urinary surgery. There is a growing tendency, however, to replace it by regional anesthesia, either spinal or epidural.

(*a*) For **spinal anesthesia** stovaine has been almost entirely abandoned in favor of procaine in a 4 per cent. sterilized solution or in powder form (0.1 to 0.12 gram of the powder being mixed at the time of operation with 3 c.c. of cerebrospinal fluid).*

The usual dose for anesthesia varies from 0.08 gram (1¼ grains) to a maximum of 0.12 gram (2 grains). The injection calls for certain precautions. Procaine lowering the blood-pressure, it is well to give, 2 hours before the operation, an injection of 0.25 gram (4 grains) of caffeine. One hour before the operation an injection of morphine-scopolamine should be given, and another of 0.001 gram (1/65 grain) of strychnine.

For the technic of the injection *per se* the reader is referred to the section on *Lumbar puncture.* We shall simply mention here as a useful precaution that care should be taken, *before the injection,* to withdraw a certain amount of cerebrospinal fluid—about 15 to 20 c.c.

(*b*) **Epidural** or **sacral anesthesia** has of late years been much employed.

This procedure, the credit for which is due entirely to Cathelin, has the great advantage of being absolutely harmless; it is perfectly suited for all operations on the bladder, the prostate, the perineum,

* There are on the market specially prepared ampules containing the required dose of procaine preserved aseptically.

the anus, the scrotum, etc.; the anesthesia obtained is excellent provided one waits a sufficient time between the injection of the drug and the time of operation (at least one-half hour). It is well, an hour before the operation, to give a preliminary injection of ***pantopon, paveron,*** or ***sedol*** (morphine-scopolamine).

The armamentarium required consists merely of a syringe of 20 to 30 c.c. capacity, with a steel needle with a long bevel, 6 centimeters (2⅖ inches) long and of 0.6 to 0.8 millimeter (1/40 to 1/30 inch) diameter. The syringe having been perfectly sterilized, the preparation of the anesthetic is proceeded with; the solution of the drug must be prepared just before use. In a porcelain matrass dissolve in 30 c.c. (1 fluidounce) of boiling water one of the following packets:

℞	Sodium chloride	0.1 gram.
	Sodium bicarbonate	0.15 gram.
	Procaine	0.6 gram.

(Lœven's formula).

The boiling should be continued only for a few seconds, to obviate decomposition of the drug. After the solution has cooled, 5 to 10 drops of adrenalin are added (adrenalin diminishes the anesthetic action, but prolongs it).

Of the solution thus prepared, from 10 to 20 c.c. (2½ to 5 fluidrams) are to be used for the injection.

Cathelin has many times described in a very clear manner, with circumstantial drawings, his technic of epidural injection. We shall here briefly recall its principles.

The injection is made into the sacral hiatus, at the lower extremity of the sacrum. The left index finger, following the crest of the sacrum from above downward, drops, at its extremity, into a triangular depression, with its apex upwards, the two lower angles being formed by the protruding fifth sacral tubercles. A depressible membrane, easily felt, fills the orifice through which the injection is to be made.

With the patient in lateral decubitus, and the landmark located and indicated by the pulp of the left index finger, the puncture is made by pushing the needle at right angles to the membrane until the latter is felt to have been perforated; the needle should not be pushed home completely, but almost immediately after having entered the canal, the butt of the needle should be lowered until the latter is parallel with the axis of the sacral canal. Then only, the needle is advanced into the canal for a distance of about 5 centimeters (2 inches). Care should be taken to make certain that the needle is free, that it is not penetrating too far into the canal, and that no blood nor

cerebrospinal fluid is issuing through the orifice. (The latter eventuality would occur only when the injection had been made too deeply.)

With the needle properly placed, the operator proceeds with the injection of from 15 to 25 c.c. (4 to 6¾ fluidrams) of the abovementioned solution.

HEMOSTATIC DRUGS.

ANTIPYRIN possesses hemostatic properties which are frequently resorted to in urology in cases of vesical hematuria. A sterilized 4 per cent. solution is used.

ADRENALIN in the undiluted 1:1000 solution or combined with 1 to 2 per cent. cocaine or procaine may be used for bladder irrigations or application to the urethra.

COAGULEN is a good hemostatic drug. It is a biologic product extracted from the blood platelets, which favor coagulation. It is generally employed in a 10 per cent. aqueous solution, preferably dissolved in physiologic salt solution. It is best to prepare the solution just before use. It is sterilized by boiling for a short time, and the drug can be used either by intravesical injection or with tampons (prostatectomy).

ANTHEMA, the antihemorrhagic serum of Dufour and Le Hello, manufactured by Poulenc, is an excellent hemostatic drug. It is used in intramuscular injections of 5 to 10 c.c. (80 to 160 minims).

In grave hemorrhages (vesical hematuria due to tumors, or hemorrhage following prostatectomy) there should be no hesitation in resorting to *blood transfusion,* the application of which has of late been made eminently practical and easy.

LITHOTRIPTIC AGENTS.

1. **PIPERAZIN** is a colorless crystalline substance, freely soluble in water. It is the strongest solvent of uric acid *in vitro;* it forms with uric acid urates which are soluble in 47 times their weight of water.

It may be given in doses of 0.5 to 1 gram (7½ to 15 grains) a day in solution in some carbonated water, or in a syrup or infusion.

2. **LYCETOL,** a derivative of dimethyl-piperazin, combined with tartaric acid, has the same properties as piperazin, but possibly more marked.. The dose is 0.5 to 2 grams (7½ to 30 grains) a day.

3. **URAZIN,** or piperazin citrosalicylate, is a new substance which is a definite, stable compound, soluble in water at 17° C.

to the extent of 3.75 per cent. According to prevailing theoretical considerations as regards uricemia, each of the constituents of urazin is capable of assuming a part in the treatment of this diathesis. Pharmacologic experimentation shows that piperazin citrosalicylate increases the excretion of uric acid in an animal artificially rendered uricemic. The clinical results are of the same order.

4. **LITHIUM** and its salts (carbonate, benzoate, etc.) are among the best solvents of uric acid and urates [*in vitro*].

The carbonate or benzoate may be given in doses of 0.5 to 1 gram (7½ to 15 grains) a day.

5. **POTASSIUM SALTS** (acetate, citrate, and carbonate) have been recommended in England chiefly for gout and uric lithiasis. They should be given diluted in a large amount of fluid in a daily dosage of 0.5 to 1.5 grams (7½ to 22½ grains).

6. **CINCHOPHEN** or *atophan,* chemically phenylquinolin carboxylic acid, $C_6H_5.C_9H_5N.COOH$ [*Cinchophenum,* U. S. P.] occurs as a light powder, insoluble in water, soluble in alkalies, and with a bitter, slightly pungent taste. It is a powerful uric acid eliminant (up to 216 per cent. of the amount normally eliminated daily).

It may be conveniently given in cachets of 0.5 gram (7½ grains) each, twice daily.

[The terms *neocinchophen, novatophan* and *tolysin* refer to an ethyl-methyl ester of cinchophen which is practically tasteless.—Tr.]

7. **MAGNESIUM OXIDE** seems to be the best remedy for oxalic lithiasis. It changes the insoluble calcium oxalate into magnesium oxalate, which is freely soluble and readily eliminated.

III

DRUGS ACTING ON THE RESPIRATORY SYSTEM.

Few drugs possess an action specifically related to respiration. With the exception of *oxygen,* none manifests in respect of the broncho-pulmonary system the remarkable efficiency shown by digitalis in respect of the circulatory system. The respiratory action is generally a secondary property of the drug, subordinate to a primary action either on the circulation, nervous system or blood; such, for example, is the eupneic action of iodides and of caffeine, secondary to the neuro-circulatory action of these substances, and likewise the inhibition of cough which opium produces through its action on the medulla, etc. It is, therefore, in the sections on *Dyspnea, Cough, Hemoptysis, Hyposphyxia,* etc., and in that dealing with the treatment of diseases of the respiratory tract, that the reader will find grouped together the agents to be used against these symptoms and diseases.

Oxygen therapy, practically a specific in *asphyxia,* will be described in some detail.

Aside from this measure, we shall deal here only with the *bechics* or cough sedatives and the *expectorants* or modifiers of the bronchial secretions, for the reason that some bechic or expectorant substances, such as lobelia, drosera and aconite in the first group and antimony and the creosote and turpentine derivatives in the second group, would be hard to place elsewhere.

Serum therapy and **vaccine therapy** show a tendency to assume an increasingly important place in the treatment of disorders of the respiratory tract. So far they do not lend themselves readily to a general systematization from this standpoint. The facts relating to them will be found not only in the **general sections** on serum therapy and vaccine therapy, but also in the **special sections** (pneumonia, tuberculosis, asthma, chronic bronchitis, etc.) dealing with the disorders in which favorable results have been obtained.

I—ANTI-ASPHYXIC AGENTS.

OXYGEN THERAPY.

OXYGEN.—This is, as is well known, a colorless, tasteless gas which is present in admixture with nitrogen in the atmospheric air in the ratio of 1:4. Oxygen is the agent of combustion processes in general, and of the intra-organic combustion processes in particular.

Pure oxygen has long been used by **inhalation** (see *Methods*), empirically and on the basis of *a priori* conceptions, in *asphyxial* states in general, acute or subacute (cardiopulmonary disorders, asphyxial intoxications, etc.). Its use is time-honored, one might almost say invariable, in the final dyspneic, asphyxiating, cyanosing and agonal stages of circulatory, respiratory and toxic diseases.

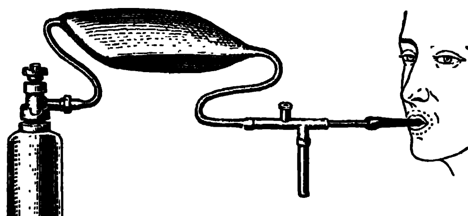


Fig. 2.—The Lian and Navarre pneumo-oxygenator.

The stricture expressed by Richaud appears to be well-founded: "The use of oxygen by inhalation to combat slow or acute asphyxias, or to increase or regularize the course of the processes of organic oxidation, has been the result of an unthinking enthusiasm. Physiology, on the one hand, and careful, impartial clinical observation, on the other, show that in the majority of circumstances under which inhalations of oxygen are used, these inhalations give no appreciable result. Pure air, free of all harmful admixture (gaseous or solid), can produce exactly the same therapeutic effects as oxygen inhalations."

There are available, however, perfected devices that permit of mixing oxygen in variable proportions with the inspired air and may render appreciable service during ascents, *e.g.*, in airplanes, and in certain emergency cases.

Intensive oxygen therapy may likewise be very effective, and its technic has recently been made practical thanks to Lian's pneumo-

oxygenator. Delcourt recommends, in infantile pneumonia and bronchopneumonia, recourse as soon as possible to oxygen, which is to be used liberally. Every quarter hour the child is to inhale oxygen for 5 minutes, with the funnel placed as near as possible to the mouth and nose; a total of 800 to 1000 liters is thus used in the 24 hours.

Lian and Navarre have devised a *pneumo-oxygenator* calculated to permit of intensive inhalations of oxygen. It consists of a mouthpiece comprising an oval part which is inserted between the teeth and lips, completely occluding the mouth while permitting movements of the jaw and tongue as well as the swallowing of saliva. This oval part of the mouthpiece has a central channel from which leads a thick rubber tube connected with a double valve. The tube enclosing the double valve is entirely of metal and sterile. It is connected on the one hand with the mouthpiece and on the other with the rubber bag. It permits of inspiration of oxygen from the rubber bag and of ejection of the expired air, its tightness being insured by two small disks of rubber which are easily changed.

The rubber bag, of 30 liters' capacity, is connected, on one hand, with the valve by an ample tube, and on the other hand with the tank of compressed oxygen.

For young children and nurslings the mouthpiece is replaced by a Camus mask.

Oxygen by Subcutaneous Injection.—While Spallanzani, it seems, was the first, in 1775, to give a subcutaneous injection of oxygen, it is only since Dominé's initial work that such injections have been practiced for a therapeutic purpose, and it has been mainly the French clinicians, particularly F. Ramond, R. Bayeux, A. Martinet, and F. Heckel, who have systematized and generalized their use. The opinion on this procedure now seems to be practically unanimous, and considerable medical literature on it has appeared.

The reader will find in the section on *Technical Procedures* the necessary details regarding the armamentarium, technic of the injections, dosage, and possible drawbacks.

Bayeux has advocated subcutaneous injection of oxygen mixed with 15 per cent. of carbon dioxide in the treatment of mountain sickness.

The *general specific indication for hypodermic oxygen therapy* is **asphyxia,** whatever be its cause, intensity and modality:

Mechanical asphyxia: Traumatic, by strangulation or immersion, occlusion or compression of the respiratory passages (croup, tumors of the neck, swellings of the larynx).

In these cases the treatment takes the form of an *emergency procedure* or temporary measure, concurrently with the other appropriate measures (artificial respiration, rhythmic traction on the tongue, etc.), while awaiting a radical procedure, such as tracheotomy, intubation, removal of a tumor, etc.

Asphyxia dependent upon some cardiopulmonary disorder:

Asthmatic dyspnea.

Dyspnea and asphyxia in lung congestion, bronchopneumonia, or lobar pneumonia.

In pulmonary tuberculosis (Bayeux), to combat congestive (hemoptysis) or asphyxial (paroxysmal dyspnea) complications.

In hyposphyxic states (A. Martinet and F. Heckel), characterized by an accidental or habitual "hyposphyxia," with purplish facies, lowered temperature and cyanosis of the extremities, small pulse, cryesthesia, and manifest impediment in venous circulation (varicose veins, distention of the veins of the neck).

Asphyxia dependent upon toxic causes:

A. EXOGENOUS: *Carbon monoxide, carbon dioxide, carbon bisulphide,* or *illuminating gas.*

In the asphyxial conditions brought on by the *asphyxiant gases,* I obtained in my service at Villemin, where the accident cases from the Courneuve factories were received, constant and most remarkable results from oxygen injections.

The investigations of Claude Bernard and Gréhant, of Balthazard and of Nicloux in pathologic physiology fully justify the use of oxygen injections in carbon monoxide poisoning. They should be used very freely. Pic and Durand, in one such case, injected 230 liters in 48 hours in fractions of 50 liters each, and saved their patient. These observers were pushing the matter rather far, but their case shows, at least, that the injection can be copious and can be measured in liters and even tens of liters in emergency cases.

B. ENDOGENOUS. Oxygen injections may also be of service in *Bright's disease* and *uremia,* but the results here are less clear-cut.

* * *

In all cases thus far reported in which this measure has been used, including cases of acute or chronic tuberculosis, bronchopneumonia, lobar pneumonia, dyspnea of mechanical causation, toxic dyspnea, and acute endocarditis, one finds mentioned, as in the cases already referred to, a slowing and strengthening of the heart-beats as the result of the treatment, together with increase of blood-pressure and slowing and increased amplitude of respiration.

The foregoing observations show that the indications for oxygen hypodermically are much more extensive than one might have suspected from the earlier contributions, and that aside from the acute asphyxial conditions (of mechanical and especially of toxic or toxic-infectious origin: pleuro-pulmonary affections, uremia, diabetes, suffocative bronchitis, pneumonia and bronchopneumonia, etc.) and acute and chronic tuberculosis, there can also be expressly mentioned the acute, and especially the chronic, hyposphyxic syndromes, which are so exceedingly common and of which the foregoing clinical varieties merely represent particular instances.

* * *

A feature I wish to point out at this time is that up to the present—judging solely from my personal experience—no form of medication has seemed to exert as rapid and as pronounced an action in lowering the viscosity of the blood as this procedure. Hypodermic oxygen therapy is, to my mind, the most active yet found of the viscosity-reducing measures.

I am glad to quote here the conclusions of Richaud, which are, on the whole, favorable:

"There is no doubt but that oxygen injected into the tissues is not only absorbed mechanically, but is capable of acting chemically, in the same manner as the oxygen fixed in the lungs, in the oxidation processes taking place in the tissues. Accordingly, when some condition or other occurs in the lungs to hinder regular oxygenation, one is justified in seeking to make up for the insufficiency of pulmonary oxygenation by the introduction of oxygen into the depths of the tissues. Thus the procedure of oxygen injection appears before us in its true light, *i.e.*, as a substitutional or vicarious procedure."

OZONE (O_3).—Ozone is obtained by means of various devices which bring into play and regulate the electric spark (various ozonizing devices, high frequency). It is possessed of oxidizing and antiseptic properties much more pronounced than those of ordinary oxygen. It is rather irritating to the respiratory mucous membranes.

I have obtained noteworthy results with it, however, in many cases of subacute or chronic rhinitis, by means of a nasal ozonizer attached to a small high-frequency apparatus.

Its use has been advocated in the treatment of whooping-cough. The typical results are, however, very inconstant.

HYDROGEN PEROXIDE (H_2O_2).—This is generally used in the form of a solution capable of setting free, in its decomposition, 10 to 12 times its volume of oxygen gas.

It is in daily use as a *surgical and buccopharyngeal antiseptic.*

MODES OF USE.

As stated by Richaud, it can be used as a *hemostatic* in *capillary* or other *hemorrhages, e.g.,* in epistaxis, postoperative pharyngeal bleeding, etc.

Surgical uses: Neutral hydrogen peroxide solution yielding 10 to 12 volumes of oxygen.

Oral antisepsis:

℞ Liquoris hydrogenii dioxidi	20	c.c.	(f℥v);
Sodii boratis	0.5	gram	(gr. viiss);
Spiritus menthæ piperitæ	5	c.c.	(♏lxxx);
Aquæ destillatæ q. s. ad	100	c.c.	(f℥iiiss).

M. Sig.: For gargling and as mouth wash.

Application for parasitic stomatitis (thrush):

℞ Sodii boratis	5 grams	(gr. lxxv);
Glycerini,		
Liquoris hydrogenii dioxidi āā	20 c.c.	(f℥v).

M. Sig.: To be applied five or six times daily with a cotton pledget.

On occasion the hydrogen peroxide might be replaced by *sodium perborate,* $NaBoO_3 + 4H_2O$, which in solution in water decomposes into sodium metaborate and oxygen. One should specify: "Saturated (*in the cold*) solution of sodium perborate." The uses of this product are the same as those of hydrogen peroxide, but it is much more expensive.

II.—EXPECTORANTS AND OTHER DRUGS ACTING ON THE BRONCHIAL SECRETIONS.

Expectorant treatment answers a very widespread indication—that of facilitating expectoration. This indication exists, at some stage in their course, in the majority of bronchopulmonary disorders.

The agents employed for the purpose are varied:

Mineral: Antimony compounds, iodides, sodium benzoate, ammonium acetate, and sulphur compounds.

Vegetable: Ipecac, senega, turpentines and their derivatives (terpin hydrate, terpinol), creosote and its derivatives (guaiacol), eucalyptus and its derivatives, etc.

In general, very little is known regarding the mode of action of these various substances, particularly in the case of turpentine. Some, such as the iodides, benzoates, and senega, really seem to exert a liquefying action; the others, such as ipecac and antimony, appear to exert a more complex action consisting of liquefaction of the secretions coupled with stimulation of the bronchial musculature

(noteworthy in the case of these drugs is the relationship existing between the expectorant and emetic actions: while expectorant in small doses, they are emetic in large); lastly, the turpentine group of drugs, seemingly stimulant to the bronchial glands, through which they are eliminated, liquefy in small doses but dry up the secretions in large.

ANTIMONY COMPOUNDS.—The **salts of antimony** are represented in this connection by *tartar emetic, antimony oxysulphide* or *kermes mineral,* and the *"white oxide of antimony."*

These compounds are indicated mainly in bronchitis with hypersecretion, prolonged catarrhal states, and bronchitis with delayed, sluggish resolution. Their depressant and hypotensor action is manifest, and is obviously related to their nauseant or actually emetic action; they should, therefore, be used only with caution in asthmatics, heart cases, and aged individuals.

Tartar Emetic, or antimony and potassium tartrate [*Antimonii et potassii tartras,* U. S. P.], occurs in transparent octahedral crystals, soluble in 2 parts of boiling water and in 14 parts of cold water. It played an extremely important rôle in therapeutics in the earlier periods, and constituted, as is well known, along with venesection, the principal agent in the famous "contro-stimulant" treatment for pneumonia and pulmonary and other congestive states. Having lost its former glory, its use is now practically limited to emesis, and even this only exceptionally, in a dose of 0.05 gram (¾ grain), usually combined with ipecac, and as an expectorant in doses of 0.01 or 0.02 gram (⅙ to ⅓ grain), as in the following solution:

℞ Antimonii et potassii tartratis .... 0.04 gram (gr. ⅔);
Ammonii acetatis .... 5 grams (gr. lxxv);
Syrupi terebinthinæ (10 per cent.) ...... 60 c.c. (f℥ij);
Aquæ aurantii florum ....q. s. ad 200 c.c. (f℥viss).
M. Sig.: One tablespoonful every two hours.

Antimony Oxysulphide, sulphurated antimony, or kermes mineral [*Antimonium sulphuratum,* N. F. IV] occurs as a purplish brown, tasteless powder, insoluble in water and in alcohol, which is used in daily amounts of 0.01 gram (⅙ grain) per year of the patient's age—0.15 to 0.25 gram (2½ to 4 grains in adults)—in tablets, pills, electuaries, or mucilaginous preparations.

Thus, one might prescribe:

℞ Antimonii sulphurati (N. F. IV) ....0.1-0.5 gram (gr. iss-viiss);
Mucilaginis acaciæ,
Syrupi acaciæ ....āā 30 c.c. (f℥j);
Aquæ aurantii florum .... 8 c.c. (fʒij);
Aquæ destillatæ ....q. s. ad 200 c.c. (f℥viss).
M. Sig.: One tablespoonful every two hours.

"**White Oxide of Antimony,**" or potassium antimonate (acid potassium metantimonate), is an amorphous, white, tasteless powder, insoluble in water and in alcohol, likewise administered in a mucilaginous preparation or electuary in average doses of 0.2 gram (3 grains) per year of the patient's age—2 to 5 grams (30 to 75 grains) in adults.

IODIDES possess, as is well known, a manifest expectorant, liquefacient property. They should be used in small doses, such as 0.25 to 1.5 grams (4 to 22½ grains) a day. One should be on the lookout for their well-known congestive effects. They are generally to be used in conjunction with other expectorants, such as sodium benzoate or senega, as will be noted later, or with drugs calculated to tone up the heart, such as caffeine, as in the following formula, frequently indicated in old catarrhal patients:

℞ Caffeinæ	0.3	gram	(gr. v);
Sodii benzoatis	4	grams	(ʒj);
Sodii iodidi	1.5	grams	(gr. xxiij);
Syrupi terebinthinæ (10 per cent.)	75	c.c.	(f℥iiss);
Aquæ aurantii florum q. s. ad	200	c.c.	(f℥viss).

M. Sig.: Four tablespoonfuls a day.

SODIUM BENZOATE, a very useful expectorant, both liquefacient and stimulant, can be strongly recommended. Of all the compounds of this series, it is perhaps the one having the broadest indications. It is administered in daily amounts of 1 to 5 grams (15 to 75 grains), alone or in conjunction with synergists:

℞ Sodii benzoatis	8 grams	(ʒij);
Syrupi terebinthinæ (10 per cent.),		
Syrupi tolu āā	45 c.c.	(f℥iss);
Aquæ aurantii florum q. s. ad	200 c.c.	(f℥viss).

M. Sig.: To be taken in two days.

AMMONIUM COMPOUNDS.—Ammonium acetate is both an expectorant and a diffusible stimulant. It is indicated in the torpid bronchitis of old persons, associated with bronchoplegia and a tendency to heart weakness.

℞ Ammonii acetatis	4 grams	(ʒj);
Spiritus vini vitis	20 c.c.	(fʒv);
Syrupi terebinthinæ (10 per cent.)	30 c.c.	(f℥j);
Aquæ aurantii florum q. s. ad	120 c.c.	(f℥iv).

M. Sig.: Three or four tablespoonfuls a day.

Mention should be made of the useful preparation sometimes known as the **anisated spirit of ammonia:**

℞ Aquæ ammoniæ fortioris	4 c.c. (fʒj);
Olei anisi	1 c.c. (♏xvj);
Alcoholis	30 c.c. (f℥j).

M. Sig.: Ten to fifty drops in sweetened water or some hot aromatic infusion.

[A similar combination is recognized in the National Formulary as *Spiritus ammoniæ anisatus.*]

GUM AMMONIAC.—Combined with sulphurated antimony, benzoic acid and balsam of tolu, gum ammoniac [a gum-resin from *Dorema ammoniacum*] forms the basis of certain expectorant pills of the following type:

℞ Antimonii sulphurati (N. F. IV) .... 0.01 gram (gr. 1/6);
Acidi benzoici .... 0.05 gram (gr. 3/4);
Ammoniaci (B. P.) .... 0.1 gram (gr. iss);
Tolu .... q. s.
Ft. pil. No. i. Da tal. No. xxx.
Sig.: Four to eight pills a day.

SULPHUR COMPOUNDS.—**Sodium hyposulphite** is, perhaps, the most effective remedy in bronchial gangrene. To it we owe a few of our most striking therapeutic successes. Prescribed in the dose of 4 grams (1 dram) a day, it rather rapidly brings about improvement in the bronchial secretion. After four to six days a marked diminution of the fetid odor and amount of sputum is observed. The drug can be prescribed simply in a mucilaginous preparation:

℞ Sodii thiosulphatis .... 6 grams (ʒiss);
Mucilaginis acaciæ,
Syrupi acaciæ ....āā 45 c.c. (f℥iss);
Aquæ aurantii florum .... 10 c.c. (fʒiiss);
Aquæ destillatæ ....q. s. ad 250 c.c. (f℥viij).
M. Sig.: To be taken in 24 hours in divided amounts.

It may instead be combined with a balsamic drug or with sodium benzoate.

In clinical therapeutics the sulphur compounds are, along with the balsams, the most effectual remedies for bronchial catarrh.

They are used largely by direct **inhalation,** in the special bathing resorts, and by **oral administration,** the action being then exerted through bronchial exhalation following their ingestion. These two procedures may be used in combination.

The inhalations are carefully regulated as to duration, temperature, and concentration of the sulphur solution; they are carried out almost entirely in the sulphur thermal resorts (such as Luchon, Cauterets, and Enghien), in special rooms in which perfected vaporizing apparatus permits of exact regulation of the temperature and the concentration of sulphide or sulphur fumes.

For these systematic inhalations, unavailable in the home, can be substituted *gargling* and *spraying* carried out, for instance, with the aid of Richardson's apparatus, using either some sulphurous water obtained from the mineral springs or an artificial sulphurous water such as:

℞ Sodii sulphatis exsiccati .... 1 gram (gr. xv);
Calcii sulphidi pulveris .... 4 grams (ʒj);
Sodii subcarbonatis pulveris .... 6 grams (ʒiss).
M. bene et div. in chart. No. lxxii.

One such powder is to be mixed into 200 to 250 c.c. (6 to 8 ounces) of water for gargling, spraying or ingestion.

Internally, one may administer:

(*a*) *Flowers of sulphur,* one teaspoonful in the morning in honey (forming a laxative preparation) or in capsules:

℞ Antimonii sulphurati (N. F. IV) .... 0.03 gram (gr. ½);
Sulphuris præcipitati,
Pulveris ipecacuanhæ et opii .... 0.1 gram (gr. iss).
Pone in caps. No. i. Da tal. No. i.
Sig.: Four to eight capsules a day.

(*b*) *Sodium monosulphide* in solution or in a syrup in doses of 0.02 to 0.06 gram (⅓ to 1 grain) a day. Thus:

℞ Sodii monosulphidi .... 0.1 gram (gr. iss);
Syrupi picis pini .... 120 c.c. (fʒiv).
M. Sig.: One tablespoonful or more morning and evening.

Or:

℞ Sodii monosulphidi (cryst.) .... 0.1 gram (gr. iss);
Aquæ destillatæ .... 1 c.c. (♏xvj);
Syrupi .... 75 c.c. (fʒiiss).
M. Sig.: Two to four tablespoonfuls a day.
(This syrup should be prepared shortly before use.—POUCHET).

(*c*) *Natural sulphurous waters.*—For patients in good circumstances, the use of the natural waters procured directly from the springs is the method of choice. The waters from the cold springs are less subject to deterioration and withstand shipment better than those from warm springs. They should be drunk in doses of 75 c.c. (½ glassful) to 150 c.c. (1 glassful) in the morning or afternoon, preferably with an equal amount of hot milk. As the waters deteriorate rapidly after the bottles are opened, quarter-bottles should be ordered, one-half of each being used for gargling and the other half for drinking. If an attempt is made to make one bottle do for two days or longer, it must be carefully restoppered and then kept inverted with the neck immersed in a receptacle containing water, so as to form an air-tight closure.

The cicatrizing, drying-out action of the sulphur products is much more marked than that of the balsams; not rarely one observes congestive exacerbations involving the bronchi and lungs during the treatment, which must, therefore, be closely supervised. Further, heart disease, Bright's disease, tubercle infection, neurovascular

erethism and a tendency to hemoptysis constitute at least relative contraindications to the treatment, or in any case necessitate more careful watching and still greater caution.

IPECACUANHA, from *Cephælis ipecacuanha* (Rubiaceæ), is, with tartar emetic, the type of the nauseant expectorants, but is much easier to administer than the antimony compound. It is particularly indicated in cases of congestive bronchitis with marked bronchial obstruction and pulmonary hyperemia in subjects still robust. Its use is contraindicated by pronounced general depression and by capillary bronchitis.

Dover's Powder, or powder of ipecac and opium [*Pulvis ipecacuanhæ et opii,* U. S. P], is used mainly in adults. It contains 10 per cent. each of ipecac and of opium, the remainder consisting of milk sugar. Its composition renders it at once a cough sedative, an expectorant and a decongesting agent. It may be used in pills, capsules or cachets in a daily dosage of 0.2 to 0.4 gram (3 to 6 grains), alone or in conjunction with other drugs, as in the following combination, which is very serviceable in heart cases:

℞ Strychninæ sulphatis .... 0.001 gram (gr. 1/65);
Sparteinæ sulphatis .... 0.02 gram (gr. 1/3);
Scillæ pulveris,
Pulveris ipecacuanhæ et opii .... āā 0.1 gram (gr. iss).
Ft. pil. No. i. Da tal. No. xx.
Sig.: Three to four pills in a day (for adults).

[*Fluidextractum ipecacuanhæ,* U. S. P., 0.06 c.c. (1 minim).

Syrupus ipecacuanhæ, U. S. P., containing 7 per cent. of the fluidextract, 0.75 c.c. (12 minims) as expectorant.

Ipecacuanha, U. S. P., 1 gram (15 grains) as emetic.

Tinctura ipecacuanhæ, N. F., containing 10 per cent. of the fluidextract, 1 c.c. (15 minims).

Tinctura ipecacuanhæ et opii, N. F., 10 per cent. each of ipecac and opium, 0.5 c.c. (8 minims).]

SENEGA, the root of *Polygala senega* (Polygalaceæ), acts both as a remedy facilitating respiration (eupneic) and as an expectorant, producing its effects in a manner no doubt very similar to that obtaining in the case of ipecac. It is used mainly in the form of a syrup [*Syrupus senegæ,* U. S. P., 20 per cent.] in an average dose of 4 c.c. (1 fluidram) or in the form of the powdered drug [*Senega,* U. S. P.] or an extract, in doses of 0.1 to 1 gram (1½ to 15 grains); in children 0.05 gram (¾ grain) of the extract may be given per year of age. The average dose of the fluidextract [*Fluidextractum senegæ,* U. S. P.] is 1 c.c. (15 minims). In upset stomach and in fever the use of senega is contraindicated.

℞ Extracti hyoscyami,
Antimonii sulphurati (N. F. IV) ....āā 0.02 gram (gr. 1/3);
Extracti senegæ,
Tolu ....āā 0.1 gram (gr. iss).
Ft. pil. No. i. Da tal. No. xxx.
Sig.: Two to ten pills a day.

℞ Fluidextracti senegæ,
Tincturæ aconiti,
Tincturæ belladonnæ ....āā 2 c.c. (f℥ss);
Aquæ laurocerasi,
Syrupi terebinthinæ (10 per cent.),
Syrupi tolu ....āā 30 c.c. (f℥j);
Aquæ aurantii florum .... 80 c.c. (f℥iiss).
M. Sig.: Four to eight tablespoonfuls a day.

TURPENTINE and its derivatives (*terpin, terebene, terpinol*) are obtained from pine resin, more especially from the *Pinus palustris* and *Pinus pinea* and from the larch, Larix *europœa,* in the case of "Venice turpentine." The oil of turpentine is extracted from the resin by dry distillation. Turpentine is eliminated mainly through the mucous membranes of the respiratory tract and the kidneys, but also to some extent through the liver and skin. It is diuretic in small and moderate doses. It is probably the most powerful drug acting on the secretions of the respiratory tract—particularly the nasal and tracheal secretions, which it dries up in large doses, sometimes thereby inducing cough and a feeling of oppression; caution and due reflection are, therefore, necessary in its use. It is employed in chronic bronchorrhea, bronchiectasis, fetid bronchitis, and gangrene of the lung.

The **oil of turpentine** [*Oleum terebinthinæ,* U. S. P., or *Oleum terebinthinæ rectificatum,* U. S. P.] is used externally for rubbings and dry or moist applications, or internally in capsules or solution, the rectified oil being used by mouth in average doses of 0.2 c.c. (3 minims) a day per year of age. Venice turpentine may also be given in 0.2 c.c. capsules, of which five to fifteen may be taken daily. [*The U. S. P. dose for adults is 0.3 c.c. (5 minims).*]

"**Terebinthina cocta**" consists of Strasbourg turpentine, from *Abies pectinata,* the silver fir, boiled in water until it will solidify on cooling.

[*Emulsum olei terebinthinæ,* U. S. P., contains 15 per cent. of the rectified oil. Dose: 2 c.c. (1/2 fluidram).

Linimentum terebinthinæ, N. F., is a solution of rosin cerate, 65 parts, in oil of turpentine, to make 100 parts.]

℞ Olei terebinthinæ rectificati .... 4 c.c. (f℥j);
Spiritus vini vitis .... 40 c.c. (f℥x);
Syrupi tolu .... 30 c.c. (f℥j);
Aquæ aurantii florum .... 20 c.c. (f℥v);
Aquæ destillatæ .... 100 c.c. (f℥iiiss).
M. Sig.: Four to six tablespoonfuls a day.

For internal use increasing preference is being given, however, to **terpin hydrate** (dihydrate of turpentine), **terpinol** (monohydrate of turpentine), and **terebene** (a mixture of several terpenes obtained by the action of sulphuric acid on oil of turpentine). These substances are almost insoluble in water, but dissolve more freely in alcohol, glycerin, and ether. They may be given in capsules, pills, cachets, or elixirs. [*Terpini hydras,* U. S. P., 0.25 gram (4 grains); *Terebenum,* U. S. P., 0.25 c.c. (4 minims).]

℞ Codeinæ .... 0.01 gram (gr. 1/6);
Terpini hydratis .... 0.1 gram (gr. iss).
Ft. pil. No. i. Da tal. No. xxiv.
Sig.: Four to six pills a day, in the later stages of bronchitis.

℞ Codeinæ .... 0.01 gram (gr. 1/6);
Terpini hydratis .... 0.1 gram (gr. iss);
Sodii benzoatis .... 0.5 gram (gr. viiss).
Ft. cachet. No. i. Da tal. No. xxiv.
Sig.: Three to four cachets a day.

℞ Terpini hydratis .... 10 grams (ʒiiss);
Alcoholis .... 180 c.c. (f℥vj);
Glycerini .... 250 c.c. (f℥viiiss).
Solve et adde:
Tincturæ vanillæ (N. F.) .... 5 c.c. (♏lxxx);
Tincturæ cacao (20 per cent.) .... 10 c.c. (fʒiiss);
Spiritus aurantii compositi .... 40 c.c. (fʒx);
Syrupi adianti .... 180 c.c. (f℥vj);
Syrupi tolu .... 240 c.c. (f℥viij).
Sig.: Two to six tablespoonfuls a day.

While using the last-mentioned preparation, the patient should be kept under observation and the medicine discontinued or reduced in the event of congestive manifestations, dyspnea, fever, or a too abrupt arrest of secretions. It is very serviceable in bronchorrhea and dragging bronchitis with copious expectoration.

Terpinol, which is not official, may be given in capsules of 0.1 c.c. (1½ minims) each; three to five capsules a day.

CREOSOTE and its derivatives (creosote carbonate, phosphite, tannophosphate, etc.) are serviceable in bronchitis in three different ways, *viz.,* as antiseptics, as expectorants, and in favoring fibrous tissue deposit. When judiciously employed, creosote certainly yields results in chronic bronchitis far superior to those obtained in tuberculosis, in which it has been so strongly recommended without justification. The average serviceable amounts are 1 to 2 c.c. (16 to 32 minims). [*Creosotum,* U. S. P., 0.25 c.c. (4 minims); *Creosoti carbonas,* U. S. P., 1 gram (15 grains).] The drugs may be given either by mouth in capsules, pills or emulsions, or by enema or hypodermic

injection. Their use should be associated with certain precautions in view of: 1. Their well-known irritant action on the mucous membranes of the digestive tract (whence the frequent intolerance on the part of the stomach and the almost absolute contraindication to them when this organ is irritable). 2. Their irritant action on the kidneys (whence the almost absolute contraindication in albuminuria). 3. Their combined congesting and desiccant action (whence the contraindication in the event of lung congestion or of an acute or subacute exacerbation in the course of a chronic bronchitis).

Entirely separate consideration should be given to the creosote derivatives, guaiacol and thiocol.

As for *guaiacol*, pure creosote, properly administered, seems to me more effectual and much less toxic—and consequently attended with less risk—than guaiacol. The latter might, however, be tried in chronic bronchitis in daily amounts of 0.1 to 0.3 c.c. (1½ to 5 minims), either in pills, in an alcoholic liquid preparation, in a 1 or 2 per cent. solution in codliver oil, or in enemas. Preference should be given to the chemically pure, crystalline guaiacol, a definite chemical compound and, therefore, superior to the necessarily impure guaiacol made from creosote. [*Guaiacol,* U. S. P., 0.5 c.c. (8 minims); *Guaiacolis carbonas,* U. S. P., 1 gram (15 grains).]

Thiocol, or potassium guaiacol sulphonate, a white odorless powder, containing 52 per cent. of guaiacol, of very low toxicity, non-irritant to the digestive tract and rather freely soluble in water (1:4), is certainly to be preferred to guaiacol. It combines, in a measure, the actions of the creosote-guaiacol group with those of the sulphur compounds. It may be given in tablets, cachets, solution, or syrup in daily average amounts of 2 to 6 grams (30 to 90 grains), preferably with the meals (see also *Pulmonary Tuberculosis*).

Following are a few illustrative formulas for the administration of these remedies:

CREOSOTE.

Pills:

℞ Creosoti (beechwood) .... 0.1 c.c. (♏iss);
Saponis .... 0.25 gram (gr. iv).
Ft. pil. No. i. Da tal. No. i.
Sig.: Eight to twenty pills a day.

Capsules:

(1) Codliver oil to which 5 per cent. of creosote has been added may be given in capsules, enough of the latter being administered to total 0.6 to 1.5 c.c. (9 to 23 minims) *per diem.*

(2) ℞ Creosoti (beechwood) .... 0.025 c.c. (♏⅛);
Tolu .... 0.05 c.c. (♏⅝);
Picis pini .... 0.12 c.c. (♏ij).
Ft. caps. No. i.

Enema:

℞ Creosoti (beechwood) .... 10 c.c. (f℥iiss);
Glycerini .... 80 c.c. (f℥iiss).
M. Sig.: One to four teaspoonfuls in a glassful of milk as an enema, to be given lukewarm and retained. Four drops of laudanum to be added in the event of intolerance.

Injection:

Sterile olive oil containing 7 per cent. of creosote may be used for this purpose. Five to 20 c.c. (80 minims to 5 fluidrams) to be slowly injected.

GUAIACOL.

The foregoing formulas are likewise available for the administration of guaiacol, but it is well to begin with smaller doses, to ascertain how much of it the patient can take.

THIOCOL.

Cachets:

℞ Pulveris ipecacuanhæ et opii .... 0.05 gram (gr. ¾);
Thiocol .... 0.5 gram (gr. viiss).
Ft. cachet. No. i. Da tal. No. xxx.
Sig.: Four to ten cachets a day.

Solution:

℞ Thiocol .... 10 grams (ʒiiss);
Tincturæ opii camphoratæ .... 12 c.c. (fʒiij);
Glycerini .... 16 c.c. (f℥ss);
Syrupi terebinthinæ (10 per cent.) .... 60 c.c. (f℥ij);
Aquæ aurantii florum .... 100 c.c. (f℥iiiss).
M. Sig.: Three to five tablespoonfuls a day.

EUCALYPTUS.—A tincture of *Eucalyptus globulus* (Myrtaceæ) may be used in daily amounts of 2 c.c. (30 minims), preferably in some balsamic preparation. For example:

℞ Tincturæ eucalypti .... 2-3 c.c. (fʒss-¾);
Syrupi terebinthinæ,
Syrupi tolu ....āā 30 c.c. (f℥j).
M. Sig.: To be taken in dessertspoonful doses.

℞ Tincturæ eucalypti .... 2 c.c. (fʒss);
Sodii thiosulphatis .... 3 grams (gr. xlv);
Syrupi terebinthinæ,
Syrupi acaciæ ....āā 30 c.c. (f℥j).
M. Sig.: One dessertspoonful every two hours.

COUGH SEDATIVES.

COMPOUNDS.	PREPARATIONS.	MAXIMUM DOSES. *Single.*	MAXIMUM DOSES. *Daily.*	PHARMACOLOGIC ACTION.	CLINICAL INDICATIONS.	CONTRA-INDICATIONS.	REMARKS.
OPIUM AND DERIVATIVES. (See also separate table.)	Preferably: Codeine. Dionin. Diacetylmorphine.	0.05 gram 0.02 " 0.01 "	0.2 gram 0.05 " 0.03 "	Inhibit cough center in medulla. Narcotic.	*Cough in general.*	*Tendency to stasis, cyanosis, asphyxia, or brain congestion.*	
BELLADONNA.	Pills (powder or extract). Tincture (10 per cent.). Syrup (10 per cent. of tincture).	0.03 gram of extract 1 c.c. 10 c.c.	0.1 gram of extract 4 c.c. 40 c.c.	Mainly antispasmodic (sedative). Depressant to vagus terminals. Mydriatic and antisudorific.	*Whooping-cough. Laryngismus stridulus. Spasmodic coughs. Asthma. Tuberculosis with sweats.*	*In case of poisoning: 1. Precipitate with tannins and iodides. 2. Remove by emetic and stomach washing. 3. Stimulate general system. Affusions. Rubbings. Alcoholic stimulants. Injection of oxygen.*	Tolerance varies greatly in different persons. Intolerance heralded by: Mydriasis. Dryness of mouth. Congestion of face. Rapid pulse. Cerebral excitation.
Lobelia.	Tincture (10 per cent.).	1.5 c.c.	5 c.c.	Cough sedative. Antispasmodic. Depressant to vagus terminals.	*Asthma. Whooping-cough.*	*Neurocirculatory depression. Contraindicated in cardiovascular asthenia.*	(See *Asthma.*)
Aconite.	Tincture (10 per cent.).	0.5 c.c.	1.5 c.c.	Cough sedative. Antineuralgic. Decongestive. Depressant to nerve centers.	*Laryngitis. Tracheitis. Bronchitis. Grippe.*	*Cardiac insufficiency. Low blood-pressure.*	(See *Cough* and *Analgesics.*)
Cherry-laurel water. (*Aqua laurocerasi, B. P.*)	0.1 per cent. of hydrocyanic acid.	2 c.c.	10 c.c.	Calmative. Sedative.	*Do.*	*Do.*	Calomel added to cherry-laurel water produces toxic mercury cyanide.

Bromides.	Solution.	2 grams	10 grams	Sedative. Nerve depressant.	*Whooping-cough. Paroxysmal cough.*	*Nervous depression. Low blood-pressure.*	In children, it is customary to give preference to calcium bromide in doses of 0.1 to 0.2 gram per year of age in a syrup or solution.
Antipyrin.	Solution.	1 "	4 "	Do. Analgesic. Antipyretic.	*Do.*	*Poor nutritive state.*	
Valerian.	Fluidextract. Tincture.	5 "	25 "	Sedative. Antispasmodic.	*Do.*	*Do.*	
Bromoform.	Syrup. Elixir. Oily electuary.	0.5 c.c.	1.5 c.c.	Cough sedative. Narcotic.	*Whooping-cough. Refractory paroxysmal coughs.*	*Cyanosis. Somnolence. Neurocardiac depression. Tendency to fainting spells.*	Bromoform water is used in the same doses (30 to 60 c.c.) and under the same circumstances as chloroform water.
	Saturated bromoform water.	20 c.c.	100 c.c.	Depressant to cough centers.			
Chloroform.	Mucilaginous, oily or glucose-containing liquid preparations.	0.5 c.c.	3 c.c.	Do.	*Do.*		
	Saturated chloroform water.	20 to 100 c.c.	Do.				
Ethyl formate (Æthone).	Volatile fluid.	30 to 50 drops.	300 drops.	Depressant to cough centers.	*Whooping-cough. Paroxysmal cough.*		
Local anesthetics.							The symptoms of cocaine poisoning are:
Cocaine.	External applications of a 2 per cent. solution.			Local anesthetic.	*Nasal asthma. Coryza.*	*Cases of poisoning by 0.005 gram of cocaine have occurred.*	Sweating. Chills. Respiratory and cerebral disturbances. Fainting spells.
Stovaine.	External applications of a 2 per cent. solution.			Do.	*Cough of naso-pharyngo-laryngeal origin.*		Acceleration, then slowing, of the pulse.

Eucalyptol is a product allied to terpin; it is an oxide of terpilene and is but slightly soluble in water, though freely soluble in alcohol, ether, and oils. It acts markedly on bronchial secretion, and is especially indicated in fetid bronchitis and gangrene of the lung in daily amounts of 1 to 3 c.c. (16 to 48 minims) in capsules or by injection.

Hypodermic injections of eucalyptol in solution in oils are feasible, with or without iodoform and guaiacol:

℞ Iodoformi .... 0.5 gram (gr. viiss);
Eucalyptolis .... 10 c.c. (f℥iiss);
Olei olivæ sterilisatæ .... q. s. ad 50 c.c. (f℥xiij).
M. Sig.: Two to 20 c.c. (½ to 5 fluidrams) to be injected hypodermically in 24 hours.

℞ Iodoformi .... 1 gram (gr. xv);
Guaiacolis .... 4 c.c. (f℥j);
Eucalyptolis .... 10 c.c. (f℥iiss);
Olei amygdalæ expressi sterilisati .... 40 c.c. (f℥x).
M. Sig.: Two to 20 c.c. (½ to 5 fluidrams) in two to four injections daily.

Gomenol, or oil of niaouli, extracted by distillation from *Melaleuca viridiflora* (Myrtaceæ), consists mainly of eucalyptol. Its indications, doses and manner of use are the same. It may be given in daily amounts of 1 to 3 c.c. (16 to 48 minims) in capsules of 0.25 c.c. (4 minims) each, or by intratracheal injection or hypodermic injection of a 5 to 20 per cent. solution of gomenol in oil.

III.—COUGH SEDATIVES.

Referring the reader to the section on the treatment of cough and to the sections on *Opium, Belladonna, Antipyrin,* etc., for further information, consideration of the subject here will be limited to a summary of the most commonly used cough sedatives in the annexed synthetic table (see pp. 136-137).

IV

DRUGS ACTING ON THE DIGESTIVE SYSTEM.

Under this heading the **alkalies, purgatives** and **emetics** alone lend themselves, it seems, to an interesting classification into pharmacologic groups.

As for the many other substances exerting a definite action on the digestive functions—astringents, cholagogues, eupeptics, etc.—they are altogether too diverse in their pharmacologic nature; they will be found described at various points in Part I (opium, tannic acid, sodium salicylate, calomel, organotherapy, pepsin, pancreatin, etc.) and grouped for practical purposes in the sections referring to the symptomatology of the digestive tract, *viz.*, diarrhea, dyspepsia, jaundice, vomiting, etc., as well as in the portion of the work devoted to the treatment of disorders of the digestive tract.

The reader is, in particular, referred to the last-named section, in which he will find described the results of certain quite original investigations of Léon Meunier.

A.—ALKALIES.

SODIUM BICARBONATE; SALTS OF MAGNESIUM, CALCIUM AND BISMUTH.

SODIUM BICARBONATE.—The **therapeutic indications** of sodium bicarbonate may be summarized thus:

As a stimulant to the secretory function of the stomach it is capable, when prescribed *in small doses*—0.25 to 0.5 gram (4 to 8 grains)—*at an interval before meals,* **of enhancing gastric secretion** *in cases of hypochlorhydria.*

Again, by neutralizing, at least temporarily and partially, the acid in the stomach, and by stimulating the musculature of this organ *in intermediate or large doses*—1 to 40 grams (15 grains to 10 drams)—probably through the agency of the carbon dioxide set free from it, *it gives valuable service in the* **treatment of hyperchlorhydria.**

Stimulating oxidation processes in the internal organs and promoting urinary elimination, it proves of value in the *treatment of such conditions as* **diabetes, uricemia,** *and* **plethora.**

As a fluidifying cholagogue, stimulating biliary secretion and excretion, it is in current use in the *treatment of* **cholelithiasis.**

By virtue of its ability to alkalinize the blood, it affords a valuable treatment for acid intoxication, acetonemia, and **diabetic coma.**

It should be recalled that the administration of soluble alkalies (in large doses) is capable of inducing or favoring chloride retention, and that these products should be used only guardedly, therefore, in patients whose powers of chloride elimination are not above suspicion.

* * *

A very thorough and suggestive study concerning the treatment of gastric pain by Léon Meunier has shown that gastric pains of every variety are dependent upon disturbed evacuation and an abnormal concentration of the gastric juice, and that the gastric concentration most favorable to evacuation corresponds to $\Delta = 0.35$.

He accordingly formulates the following "general treatment" for gastric pain:

At the close of gastric digestion, when the painful sensations set in, whatever be their cause, the patient should be given a solution of one of a variety of salts, such solution, however, to have always the same definite molecular concentration.

Following, according to Léon Meunier, are the concentrations of the aqueous solutions of certain substances having a freezing point in the vicinity of $\Delta = 0.35$:

Substance	Concentration
Sodium bicarbonate	0.9 per cent.
Sodium sulphate (desiccated)	1.0 " "
Sodium phosphate	1.1 " "
Sodium citrate (desiccated)	2.0 " "
Sodium chloride	0.55 " "
Peptone	4.0 " "
Hydrochloric acid	*0.935 " "
Phosphoric acid	†2.68 " "

*[9.35 grams of the French official acid (34.4 per cent.) per liter.]
†[26.8 grams of the French official acid (50 per cent.) per liter.]

Clinically, these solutions should be ordered taken in wineglassful doses every ten minutes at the time of the pain.

The important point is to select for use, according to the existing organic or functional disturbance, one or more salts exerting a definite therapeutic action, such as the provision of chlorides, the stimulation of motility, or the neutralization of acid.

The reader will find in Part IV (under *Treatment of Diseases of the Digestive Tract*) a detailed discussion of this question by Léon Meunier himself.

MODES OF ADMINISTRATION.

SODIUM BICARBONATE:

(1) ℞ Sodii bicarbonatis .... 1 gram (gr. xv);
Olei anisi .... gtt. j.
Pone in chart. No. i. Da tal. No. xii.
Sig.: One powder in a glass of water or of some simple infusion (for *pyrosis* and *burning sensations in the stomach*).

(2) ℞ Sodii bicarbonatis ....0.5-1 gram (gr. viiss-xv).
Pone in cachet. No. i. Da tal. No. xii.
Sig.: One cachet two hours after the meal (in *hyperchlorhydria*).

(3) ℞ Sodii bicarbonatis .... 10 grams (ʒiiss);
Aquæ destillatæ .... 1 liter (Oij).
S. Sig.: To be taken in wineglassful doses an hour or two after the meal (for *painful attacks of the gastralgic type*).

(4) ℞ Sodii bicarbonatis,
Sodii benzoatis ....āā 8 grams (ʒij);
Syrupi .... 225 c.c. (f℥viiss).
M. Sig.: Three to six tablespoonfuls a day (in *gout* and *chronic rheumatism*).

INTRAVENOUS INJECTION (*diabetic coma*):

(1) *Dilute solution:*

℞ Sodii bicarbonatis .... 10 grams (ʒiiss);
Liquoris sodii chloridi physiologici .... 1 liter (Oij).
Sig.: Two to six liters (!) in 24 hours (M. LABBÉ).

(2) *Concentrated solution:*

Sodium bicarbonate solution, 10 per cent. To be sterilized.
Dose: 100 to 200 c.c. (3 to 6 fluidounces). (SICARD and SECLIN.)

FOR EXTERNAL USE (as mouthwash, gargle or for bowel irrigation):

(1) ℞ Sodii bicarbonatis .... 10 grams (ʒiiss).
Pone in chart. No. I.
Sig.: For external use; dissolve in 1 liter (quart) of water.

(2) ℞ Sodii bicarbonatis,
Sodii chloridi ....āā 4 grams (ʒj).
Pone in chart. No. I.
Sig.: Dissolve in 1 liter (quart) of water.

BICARBONATE MINERAL WATERS:

Vichy:

Thermal springs: *Grande-Grille* (42° C.); *Hôpital* (34° C.).
Cold springs: *Célestins* (14° C.).
Contain about 5 grams of sodium bicarbonate, 0.5 gram of sodium chloride, and 0.002 gram of sodium arsenate per liter.

Vals:

La Marquise (13° C.)	: 7.1 grams sodium bicarbonate	+ 0.003 gram sodium arsenate.
Rigoletto	: 5.8	
Dominique	: 5.8	
Saint-Jean	: 1.4	

Pougues:

Saint-Léger (12° C.): 0.8 gram sodium bicarbonate and 2 grams calcium bicarbonate.

Saint-Nectaire:

Source des Dames: 2.6 grams sodium bicarbonate, 0.45 gram calcium bicarbonate, and 0.25 gram magnesium bicarbonate.

[For the corresponding springs in countries other than France see the section on *Crenotherapy*, this Volume.]

VARIOUS COMBINATIONS:

(1) ℞ Antipyrinæ,
Sodii bicarbonatis ....āā 0.5 gram (gr. viiss).
Ft. cachet. No. i. Da tal. No. xx.
Sig.: One to six cachets a day (for *neuralgia* and *neuroarthritic diabetes*).

(2) ℞ Sodii salicylatis,
Sodii bicarbonatis ....āā 8 grams (ʒij);
Spiritus vini vitis .... 40 c.c. (fʒx);
Syrupi aurantii .... 150 c.c. (f℥v).
M. Sig.: Four or five tablespoonfuls a day (in *rheumatic fever, gout, cholelithiasis, or cholecystitis*).

(3) *Rivière's solution:*

(*a*) Alkaline solution:

℞ Sodii bicarbonatis .... 2 grams (gr. xxx);
Aquæ destillatæ .... 50 c.c. (f℥iss);
Syrupi .... 12 c.c. (fʒiij).—M.

(*b*) Acid solution:

℞ Acidi citrici .... 2 grams (gr. xxx);
Aquæ destillatæ .... 50 c.c. (f℥iss);
Syrupi limonis .... 12 c.c. (fʒiij).—M.
Single spoonfuls of the two solutions are given in alternation, beginning with solution (*a*). (For *vomiting*, carbon dioxide being set free from the solutions in the stomach.)

(4) *Effervescent antineuralgic powders:*

℞ Morphinæ hydrochloridi .... 0.01 gram (gr. ⅙);
Antipyrinæ .... 1 gram (gr. xv);
Sodii bicarbonatis .... 2 grams (gr. xxx);
Acidi citrici,
Acidi tartarici ....āā 1 gram (gr. xv);
Lactosi .... 5 grams (gr. lxxv).
Pone in chart. No. i.
Sig.: To be taken in a wineglassful of water.

(5) ℞ Sodii sulphatis .... 4 grams (ʒj);
Sodii salicylatis .... 6 grams (ʒiss);
Sodii bicarbonatis .... 8 grams (ʒij).

Pone in chart. No. i.

Sig.: Dissolve in 1 liter (quart) of water; take one to two small tumblerfuls a day, one hour before meals. (For *cholelithiasis, biliary tract infection, or hepatico-biliary insufficiency.*)

(6) *Bourget's solution:*

℞ Sodii sulphatis .... 4 grams (ʒj);
Sodii phosphatis .... 6 grams (ʒiss);
Sodii bicarbonatis .... 8 grams (ʒij).

Pone in chart. No. i.

Sig.: Dissolve in 1 liter (quart) of boiled water. To be taken in one-half glassful doses in *gastralgia of the hyperchlorhydric type.*

(7) *Artificial Carlsbad salt:*

℞ Pulveris potassii sulphatis exsiccati ...... 5 grams (gr. lxxv);
Pulveris sodii bicarbonatis exsiccati ...... 20 grams (ʒv);
Pulveris sodii chloridi exsiccati .... 100 grams (ʒxxv);
Pulveris sodii sulphatis exsiccati .... 250 grams (ʒlxiiss).

M., cola, et conserva in lagena bene obturata.

Sig.: One to two teaspoonfuls a day in ½ to 1 liter (1 to 2 pints) of water or one or two glasses of Vichy water. (In *obesity, plethora, cholelithiasis,* or *gout.*)

[*Sal Carolinum factitium effervescens,* N. F., 4 grams (60 grains), to be taken in 200 c.c. (1 tumblerful) of water.]

(8) ℞ Potassii iodidi .... 1 gram (gr. xv);
Sodii phosphatis,
Sodii sulphatis,
Sodii benzoatis ....āā 3 grams (gr. xlv);
Sodii bicarbonatis .... 10 grams (ʒiiss).

Pone in chart. No. i.

Sig.: Dissolve in 1 liter (quart) of water; take one-half glassful one-half hour before each meal and on retiring. (For *alcoholic cirrhosis.*) (A. Robin.)

(See also Part IV, *Diseases of the Digestive Tract,* by Léon Meunier.)

INSOLUBLE ALKALIES.

SALTS OF MAGNESIUM, CALCIUM, AND BISMUTH.—The insoluble neutralizing alkalies, such as *magnesia, calcium carbonate,* and *bismuth,* the antacid properties of which are as marked as those of sodium bicarbonate and which are much less strongly excitant than the latter, the reaction of neutralization in the stomach giving rise neither to carbon dioxide nor to sodium chloride—excitomotor and excitosecretory agencies—*should be preferred to sodium bicarbonate in severe attacks of hyperchlorhydria and,* a fortiori, *in cases of ulcer.*

MODES OF ADMINISTRATION:

(1) Tablets of magnesium hydroxide can be prepared and may be given with a little water in cases of gastralgia of the hyperchlorhydric type with burning sensation, pyrosis, and a tendency to constipation.

(2) Tablets of calcium carbonate may be used upon the advent of pain of the hyperchlorhydric type in cases in which there is associated a tendency to diarrhea.

(3) ℞ Bismuthi subcarbonatis .... 4-10 grams (ʒj-iiss).
Pone in chart. No. i. Da tal. No. x.
Sig.: One powder in a half-glassful of water morning and evening, and if necessary also in the course of the day (for *paroxysmal pain* in *gastric ulcer*).

(4) ℞ Magnesii carbonatis,
Sodii bicarbonatis,
Calcii carbonatis præcipitati ....āā 0.3 gram (gr. v).
Pone in cachet. No. i. Da tal. No. xx.
Sig.: Three to six cachets a day after meals, according to needs.

(5) ℞ Belladonnæ foliorum pulveris .... 0.02 gram (gr. ⅓);
Sodii bicarbonatis,
Cretæ præparatæ,
Magnesii oxidi,
Bismuthi subcarbonatis ....āā 0.5 gram (gr. viiss).
Pone in chart. No. i. Da tal. No. xx.
Sig.: One powder in a glass of water one to two hours after meals, if pain sets in.

(6) Magnesia, lime, and bismuth (subcarbonate or subnitrate) can be administered in suspension in a mucilaginous mixture, *e.g.*:

℞ Bismuthi subcarbonatis .... 4 grams (ʒj);
Tincturæ opii camphoratæ .... 12 c.c. (fʒiij);
Glycerini .... 24 c.c. (fʒvj);
Syrupi acaciæ,
Aquæ destillatæ ....āā 60 c.c. (f℥ij).

[(7) *Magma magnesiæ*, U. S. P., 4 c.c. (1 fluidram).

(8) *Magma bismuthi*, N. F., 4 c.c. (1 fluidram).]

B.—CATHARTICS.

HOW TO PRESCRIBE CATHARTICS.—Classification of the Cathartics.—A classification based on the principle of the relationship of characteristics can alone be availed of at the present time. Such is the classification of Patein, adopted herein:

1. *Mechanically acting cathartics,* exerting their effect merely by acting on the reflex sensitiveness of the bowel: Cereals, charcoal, oils, agar-agar, liquid petrolatum.

2. *Cathartics acting on biliary secretion,* or *cholagogues:* Calomel, bile.

3. *Cathartics that increase intestinal secretion without causing exaggerated peristaltic movements* (saline and saccharine purgatives).

4. *Muscular cathartics, acting solely on the contractions of the muscular fibers, without acting on secretion* (nux vomica, belladonna).

5. *Cathartics that increase intestinal secretion and cause violent peristalsis—drastics* (scammony, aloe, jalap, croton oil).

Lastly, it seems expedient to recognize a special supplementary and provisional division for certain cathartics lately introduced in therapeutics, *viz.*, the *synthetic cathartics,* of which *phenolphthalein* is the type, and the pharmacodynamic action of which is not yet precisely known.

6. *Synthetic cathartics* (phenolphthalein).

Mechanically Acting Cathartics.—The effect of the mechanically acting cathartics is practically entirely due to their bulk, which distends the bowel and reflexly induces the need of expulsion: in a sense, they may be said to act by indigestion. They are harmless, non-irritant to the intestine, and their use may, therefore, be continued for a long time without disadvantage. They comprise the *cereals, charcoal,* the *oils, castor oil, agar-agar,* and *liquid petrolatum* (mineral oil). The last-named agent, an actual lubricant to fecal passage in the intestine, singularly facilitates progression of the feces, obviating spastic blocking of the bowel. These agents are particularly serviceable in *chronic constipation,* whether of *mechanical or spastic origin.*

Cholagogue Cathartics.—The cholagogue cathartics are those which appear to act chiefly on the secretion or excretion of bile and consequently on the bowel, bile exerting a manifest action on the regularity of the intestinal functions (obstinate constipation in cases of obstructive jaundice).

The type of these drugs is represented by *calomel* or protochloride of mercury, which is a powerful agent in respect of the liver and intestine—the "king of cholagogues;" the "cinchona" or "digitalis" of the liver.

Bile extracts can be considered only as auxiliary agents; they are not cathartics *per se.*

Saccharine and Saline Purgatives.—The saccharine and saline purgatives act in a manner entirely different from the preceding agents, *increasing intestinal secretion without inducing exaggerated peristalsis.*

The SACCHARINE PURGATIVES are, strictly speaking, laxatives rather than purgatives; in fact, they are gently acting laxatives, easily administered, and used more particularly in children.

Their main representatives are *honey, glycerin,* and *manna. Buttermilk* and *grape cures* may, in a measure, be considered allied to these agents.

The SALINE PURGATIVES, the action of which is still to some extent obscure, in all likelihood act through *exosmosis* as well as through a reflexly produced *active hypersecretion of the mucosa* including in particular

the glands of Lieberkühn. [The osmotic action is by many considered the chief factor in their effect.—TR.].

EFFECTS OF THE SALINE PURGATIVES.—1. They *empty the bowel,* causing evacuation of accumulated fecal material, bile, gases, and undigested food.

2. They are *depuratory,* removing from the system an appreciable amount of organic wastes and toxic products.

3. They are *derivative,* bringing about a more or less active congestion of the bowel and withdrawing from the blood a certain amount of water and salts.

4. They exert a *manifest action on the hepatic and intestinal secretions,* which they stimulate (presence of bile and intestinal secretion in the stools).

5. Secondarily, they may exert *a regulating or disturbing action on the circulation* (slowing) and *on the nervous system* (sedative effect).

The drugs used for saline purgation are represented mainly by the salts of magnesium and of sodium:

Magnesium oxide, magnesium hydroxide, magnesium sulphate, magnesium citrate, sodium sulphate, and the purgative mineral waters.

Muscular Cathartics.—The muscular cathartics, *acting solely on the contraction of the muscle fibers, without marked action on secretion,* are seldom employed alone, at least for cathartic purposes.

The type of this group is **belladonna,** with *hyoscyamus* and *nux vomica* as subsidiary members. The fact that their action on the intestinal mucosa is practically nil makes them almost wholly devoid of any depuratory or derivative influence. Consequently, while useful in habitual constipation, they are of little service in the conditions sometimes designated as "gastro-intestinal upsets," whether or not accompanied by fever, and in disorders in which a depuratory or depleting action through increased secretion appears to be the principal indication, such as heart failure or uremia.

Drastic Cathartics.—The cathartics which *increase both intestinal secretion and peristaltic motion* are the most active, and also the most severe. Among these, the *drastics* (jalap, scammony, croton oil) are the most irritating, and should be used only for the purpose of producing an intense derivative action toward the intestine; they are contraindicated in cases of intestinal inflammation.

They are mainly represented by jalap: *Exogonium purga* (Convolvulaceæ); scammony: *Convolvulus scammonia* (Convolvulaceæ); croton oil; cascara: *Cascara sagrada* or *Rhamnus purshiana* (Rhamnaceæ); rhubarb: *Rheum officinale* (Polygonaceæ); senna: *Cassia angustifolia* (Leguminosæ); aloe: *Aloe socotrina,* etc.; gamboge: *Garcinia Hanburyi* (Gut-

tiferæ); colocynth: *Citrullus colocynthis* (Cucurbitaceæ), and bryonia: *Bryonia dioica* (Cucurbitaceæ).

These are the active constituents of innumerable laxato-purgative preparations having an established position through custom and popularity extending over several centuries.

Synthetic Cathartics.—The question of the synthetic cathartics, opened over a century ago—chrysophanic acid having been extracted from rhubarb in 1814—actually entered the realm of practical considerations in 1903, when *phenolphthalein* was introduced into clinical medicine as a laxative and purgative for ordinary use.

It would be venturesome to think that pharmacologic evolution has come to a close with the recognition of the purgative properties of phenolphthalein. In conformity with the henceforth inescapable rules of pharmacodynamic study, this substance has been the starting-point in the preparation of a large number of substituted derivatives, of which some, containing halogens, are likely to have interesting clinical applications. It may already be said, indeed, that the problem of obtaining a non-irritant cathartic which can be administered hypodermically has been experimentally solved, and will soon be solved for clinical purposes. At the present time, however, phenolphthalein is alone used in this connection.

Phenolphthalein probably belongs in the class of the intestinal irritants, but its action seems to be accompanied by less untoward manifestations than the majority of cathartics of this class.

WHEN AND HOW CATHARTICS SHOULD BE ADMINISTERED.—While awaiting, and recognizing the possibility of, a more complete classification, we may provisionally reduce to three the indications for catharsis:

1. To rid the intestine of obstructing material (feces, bile, organic wastes, toxic substances, undigested food); for this purpose the *evacuating action* of the cathartics is used, and along with it depuratory and antiseptic effects may be exerted.

2. To displace toward the intestine an appreciable amount of blood—the *derivative action,* which tends to deplete and decongest other regions of the body.

3. To withdraw from the system a varying amount of fluid, thus bringing about a species of bloodless venesection—the *subtractive action.*

Evacuating Action.—Constipation (see also the separate section on *Constipation*).—In *intestinal occlusion,* the drastic, muscular, or mechanically acting cathartics are appropriate only where the condition is running a slow course, *viz.,* in fecal obstruction due to atony of the large intestine,

particularly in old persons. On the other hand, *all purgation is formally contraindicated, and most particularly the strongly active cathartics (drastics and muscular group), in volvulus, intussusception, internal or external strangulation, appendicitis, and peritonitis,* for which surgical treatment is practically alone indicated.

In *gastro-intestinal upsets* or *indigestion,* the milder purgatives, such as castor oil and the salines, should be prescribed according to the acuteness of the symptoms and the extent of constitutional disturbance. The saline purgatives are more especially indicated where a gastric upset is associated with *diarrhea.*

In *typhoid fever,* the evacuant purgative method of Louis has been generally abandoned on the ground that it predisposes to perforation; indeed, purgatives are scarcely used in this condition unless there is constipation.

In *dysentery,* the neutral salts in the milder forms and calomel in the more severe forms are the purgatives of choice; furthermore, in neither case should large doses be prescribed. In this connection the composition of *Segond's antidysenteric pills* may be recalled:

℞ Extracti opii (N. F.) .... 0.05 gram (gr. ¾);
Hydrargyri chloridi mitis .... 0.2 gram (gr. iij);
Ipecacuanhæ pulveris .... 0.4 gram (gr. vj);
Syrupi rhamni catharticæ (N. F.),
vel Extracti rhei .... q. s.

Ft. pil. No. vi.
Sig.: One pill every two hours.

Mucomembranous enterocolitis is the most refractory of intestinal disorders; the administration of purgatives is a ticklish matter in these cases, since "the ideal purgative that will play the part of a simple evacuant without any action on the mucous membranes of the digestive tract does not exist." Preference should be given to the *laxatives:* Castor oil; liquid petrolatum (one teaspoonful before breakfast); sodium or magnesium sulphate (6 to 8 grams—1½ to 2 drams—in the morning); podophyllin or belladonna (0.01 gram—⅙ grain—at night); magnesium oxide (0.5 to 1 gram—7½ to 15 grains—after each meal); cascara sagrada, etc. The use of these drugs should be alternated with *copious irrigations.*

In *lead poisoning, cholagogues* should be ordered, such as aloe, compound jalap tincture, podophyllin, sodium salicylate, or euonymin.

In Uremia.—Any of the cathartics may be employed. Gübler preferred the *saline* purgatives to the drastics; English physicians give mainly *calomel,* which is little used in France. Recourse is oftenest had to the *drastics,* such as scammony and jalap, compound tincture of jalap alone or in conjunction with syrup of rhamnus cathartica (buckthorn), or a cathartic enema containing senna and sodium sulphate.

In **biliary obstruction** and **hepatitis,** the purgatives enhance the biliary circulation, combat infection, and hinder the absorption of toxic material. The cholagogues, calomel, sodium salicylate, and sodium benzoate, are more especially indicated, but one may also use castor oil, senna, aloe or aloin.

Derivative Action.—The cathartics, bringing about a more or less pronounced influx of blood toward the intestinal mucosa, may be employed in order to divert from other organs the blood that had been passing into them in excessive amount.

In *cerebral congestion,* one may use the saline purgatives or drastic cathartics, as well as aloe, according as the congestion is habitual or casual. In the severe cases, the patient should be bled and given a drastic, preferably compound tincture of jalap.

These measures also apply in *congestion of the eyes, lungs or kidneys.*

In *abdominal congestive states,* the same indication obtains, but it should be borne in mind that aloe markedly congests the pelvic organs, in particular the uterus and rectum, and is, therefore, contraindicated in cases of pregnancy, uterine congestion, and hemorrhoids; on the other hand, it is especially indicated for promoting the menstrual flow and for bringing back, if this be desirable, hemorrhoidal extravasation.

Subtractive Action.—The withdrawal of an appreciable amount of fluid from the system constitutes an actual "bloodless venesection" which, like blood-letting, lowers the blood-pressure, activates absorption of extravascular fluids, and favors loss of body weight.

On this basis the cathartics find an indication in *heart failure,* in which, acting on the venous pressure, they contribute to relieving the heart, and in addition, facilitate the absorption and elimination of effused fluids. A diet of milk, the heart-tonics, the diuretics, and the purgatives constitute in general, the treatment of heart failure, and I have already pointed out (see *Digitalis*) that the following combination rather happily answers these several indications:

℞ Digitalis pulveris,
Scillæ pulveris,
Resinæ ipomœæ ....āā 0.05 gram (gr. ¾).
Ft. pil. No. i. Da tal. No. xx.
Sig.: To be taken in the course of three days.

This same action may be utilized in the treatment of *dropsy* of cardiac or renal origin and the various effusions into serous cavities or interstitial tissues (ascites, pleurisy, pericarditis, edema, etc.).

Finally, on account of the subtractive action they exert and the changes in metabolism they bring on, the use of cathartics is justifiable in the treat-

ment of *obesity* and *polysarcia;* to be effective, however, their use should be combined with strict alimentary hygiene, amounting to a more or less disguised course of dieting, together with progressive exercise therapy.

CATHARTIC PREPARATIONS.—Pills.—Innumerable are the cathartic pills that have afforded free bowel action to countless patients and brought fortune to successive generations of drug manufacturers. Chronic constipation is, indeed, the promised land to all proprietary "pharmacologists."

The reasons for this century-old, indeed millennial, popularity are only too obvious. Tastelessness, discretion, small bulk, easy preservation, and *relatively* low cost.

An entire volume could be filled with the formulas of various cathartic pills. Only a few typical combinations will be given here:

Aloe is the foundation of a great many cathartic pills because it has the property of causing an especial stimulation of the distal portion of the large bowel, atony of which is the commonest cause of habitual constipation. Among the best-known have been, perhaps, *Anderson's pills* or compound pills of gamboge:

℞ Olei anisi .... 0.01 gram (gr. 1/6);
Cambogiæ pulveris,
Aloes ....āā 0.1 gram (gr. iss);
Mellis .... q. s.
Ft. pil. No. i. Da al. No. xx.
Sig.: Two to six pills a day (in the absence of contraindications).

The above is a well-studied type of pill upon which may be based other similar formulas. It includes, indeed, an *active drug* (aloe), combined with a *synergist* (gamboge) which reinforces its action, and a *corrective* (anise) which very materially attenuates the griping which the aloe and gamboge would otherwise produce. The whole is coated with honey which makes it pleasant to take; it, therefore, provides practically an ideal combination: certainty of action, painless effect, and pleasant taste.

The following formula, which I have been using for several years, yields even more constant and more satisfactory results:

℞ Extracti hyoscyami .... 0.02 gram (gr. 1/3);
Extracti cascaræ sagradæ,
Extracti rhei,
Euonymini ....āā 0.05 gram (gr. 3/4);
Mellis .... q. s.
Ft. pil. No. i. Da tal. No. lx.
Sig.: Two or three pills a day, with the meals.

Combinations.

The following time-honored heart-tonic, diuretic and cathartic combination may be recalled:

℞ Scillæ,
Scammoniæ,
Digitalis ....āā 0.05 gram (gr. ¾).
Ft. pil. No. i. Da tal. No. xx.
Sig.: Six to eight pills daily for three days (*heart weakness*).

In *heart cases with congested liver* and in *edema of cardiac origin*, calomel should be combined with the heart tonics and diuretics, as in the following prescriptions:

℞ Hydrargyri chloridi mitis .... 0.1 gram (gr. iss);
Scillæ,
Digitalis ....āā 0.05 gram (gr. ¾);
Syrupi rhamni catharticæ, N. F. .... q. s.
Ft. pil. No. i. Da tal. No. xii.
Sig.: Two to four pills a day (watch for ptyalism).

℞ Digitalis pulveris .... 1 gram (gr. xv);
Hydrargyri chloridi mitis .... 2 grams (gr. xxx);
Scillæ pulveris .... 3 grams (gr. xlv);
Extracti ergotæ aquosi (N. F.) .... 4 grams (ʒj).
Ft. pil. No. xl.
Sig.: Four pills a day (watch for ptyalism). (LIÉGEOIS).

Following are the general features of some of the cathartic pills most commonly used in France:

(1) A combination of aloe, gamboge, jalap and rhubarb in silver-coated 0.1 gram pills, including 0.04 gram (⅔ grain) each of aloe and jalap. One to six pills a day, as laxative or cathartic.

(2) A combination of aloe, cinchona and cinnamon in silver-coated 0.2 gram pills, each containing 0.1 gram (1½ grains) of aloe. One or two pills before meals, for laxative and tonic purposes.

(3) Cascara pills each containing about 0.1 gram (1½ grains) of the extract. One to six pills a day, according to whether a laxative or cathartic effect is desired.

(4) Podophyllin pills, containing also extract of gentian. One pill on retiring and the next morning before breakfast.

(5) Cascara pills each containing about 0.15 gram (2¼ grains) of the extract, with soap as excipient. Two pills in the morning for laxative, five pills for cathartic purposes.

Solutions.

1. These are represented mainly by the *purgative mineral waters*. The natural purgative mineral waters all contain sodium sulphate or magnesium sulphate, frequently both, with or without adjunction of the chlorides of sodium, magnesium, and calcium.

Following are among the best known European purgative mineral waters:

Pullna, Sedlitz (Czecho-Slovakia); Birmensdorf (Switzerland); Epsom (England); Hunyadi-Janos, Francis-Joseph, Royal Hungarian (Hungary); Rubinat, Carabaña (Spain); Brides, Montmirail, Miers (France).

Separate mention should be made of the Châtel-Guyon water, which is a sodium chloride purgative water.

[For the American purgative waters, see section on *Crenotherapy,* this Volume.]

2. *Sodium sulphate* (Glauber salt) and *magnesium sulphate* (Epsom salt) are very simply prescribed in a purgative dose of 30 to 50 grams (1 to $1\frac{2}{3}$ ounces), in a large tumblerful of plain water, orangeade, lemonade, or water containing cane or milk sugar.

3. A convenient plan for administering *sodium sulphate in divided amounts* consists in giving it in a dose of 1 to 3 teaspoonfuls in the morning shortly before breakfast, in 120 to 200 c.c. (4 to $6\frac{1}{2}$ ounces) of warm Vichy water. A kind of artificial Carlsbad water treatment is thus obtained.

4. *Magnesium citrate* is, perhaps, the most pleasant to take of the saline purgatives. The average purgative dose of the salt is 50 grams ($1\frac{2}{3}$ ounces). As it deteriorates readily, it is best prepared shortly before use by the interaction of citric acid and magnesium carbonate. The following *effervescent purgative lemonade* may be used:

℞ Acidi citrici	30 grams	(℥j);
Magnesii carbonatis	20 grams	(ʒv);
Syrupi limonis	20 c.c.	(fʒv);
Aquæ	180 c.c.	(f℥vj).
Ft. sec. art.		
Sodii bicarbonatis	4 grams	(ʒj).
(To be added just before closing the bottle.)		

[*Liquor magnesii citratis,* U. S. P., average dose, 350 c.c. (12 fluidounces).]

Powders. Tablets. Cachets.

(1) ℞ Carbonis ligni,
Magnesii oxidi ....āā 0.5 gram (gr. viiss).
Pone in cachet. No. i. Da tal. No. xx.
Sig.: One cachet one and a half hours after the noon and evening meals.

The above is serviceable as a mild laxative in *dyspeptic* patients with *fermentative disturbances.*

(2) *Calomel,* 0.05 gram ($\frac{3}{4}$ grain) *per year of age.* It is insoluble. Chlorides, bromides and iodides are to be avoided when it is taken.

℞ Hydrargyri chloridi mitis .... 0.05-0.1 gram (gr. ¾-iss);
Sacchari cum vanilla (1 per cent.)
vel lactosi .... 1-3 grams (gr. xv-xlv).
Pone in chart. No. i.
Sig.: To be taken in water or milk. (*For children.*)

℞ Hydrargyri chloridi mitis .... 0.5-1 gram (gr. viiss-xv);
Sacchari cum vanilla (1 per cent.) vel
lactosi .... 10 grams (ʒiiss).
Div. in chart. No. ii.
Sig.: To be taken in water or milk, five minutes apart. (*For adults.*)

3. *Agar-agar,* which exerts a purely mechanical action, is often prescribed in combination with a small quantity of an active cathartic, *e.g.,* 6 per cent. of *frangula* or other species of *Rhamnus,* which do not add any irritant action on the intestinal mucous membrane. [*Phenolphthalein* is sometimes added instead.] The agar occurs in thin, translucent, yellowish pieces, which may be incorporated in various foods, such as vegetable purées, marmalades, fruit jellies, and milk or other cold liquids, and used in doses of 1 to 5 teaspoonfuls a day [*Agar,* U. S. P., 10 grams (2½ drams)]. The drug is also used in *tablets* or *cachets* to be taken after meals, or in *granular* form.

4. Most of the drastics lend themselves very well to the preparation of *tablets* or *cachets.* For example:

℞ Rhei pulveris,
Cascaræ sagradæ pulveris ....āā 0.5 gram (gr. viiss)
Ft. cachet. No. i.
Sig.: To be taken before a meal, as laxative.

Oils.

CASTOR OIL.—Laxative dose, 5 to 10 c.c. (80 minims to 2½ fluidrams); cathartic dose, 20 to 30 c.c. (5 to 8 fluidrams). [*Oleum ricini,* U. S. P., average dose, 15 c.c. (4 fluidrams).]

Castor oil may be given:

Pure or in coffee, bouillon, or milk.

Beaten into a mayonnaise in hot milk, sweetened and flavored with orange flower.

Between the juices of two oranges.

Mixed with syrup and suspended by addition of Seltzer water.

Emulsified with yolk of egg in water flavored with orange flower.

In a liquid prescription:

(*a*) For children:

℞ Olei ricini .... 4-10 c.c. (fʒi-iiss);
Glycerini .... 8 c.c. (fʒij);
Aquæ menthæ piperitæ .... 5 c.c. (♏lxxx);
Olei menthæ piperitæ .... gtt. ij. —M.

(*b*) For adults:

℞ Olei ricini .... 30 c.c. (f℥j);
Spiritus vini vitis .... 5 c.c. (♏lxxx);
Glusidi .... 0.25 gram (gr. iv);
Olei anisi .... gtt. xxx. —M.

In *capsules* each containing 4, 6, or 8 c.c. (1, 1½, or 2 fluidrams).

LIQUID PETROLATUM ("MINERAL OIL").

This substance, although of an oily consistency, is not a true oil, as it does not belong to the series of fatty compounds, but is a mixture of hydrocarbons which is liquid at ordinary temperatures.

It has come into extensive use in habitual constipation in doses of one dessertspoonful to one tablespoonful in the morning early or at breakfast. [*Petrolatum liquidum*, U. S. P., average dose, 15 c.c. (4 fluidrams).]

It is taken pure or flavored according to individual preference with some form of fruit juice, if necessary with addition of sugar and vanilla or disguised in one of the ways mentioned above for castor oil.

CROTON OIL.

This is a drastic cathartic of the most violent type and its use is gradually diminishing. I have seen it exert remarkable derivative effects, however, in cases of grave congestion of the lungs or brain in robust plethoric patients. Dose, 1 or 2 drops in pills or in olive oil.

℞ Olei tiglii .... gtt. j;
Saponis .... 0.2 gram (gr. iij).
Ft. pil. No. i.
Sig.: One or two pills.

Tinctures.

COMPOUND TINCTURE OF JALAP.

This preparation has a particularly unpleasant, bitter taste. It may be given in doses of 4 to 20 c.c. (1 to 5 fluidrams) with syrup of senna or of rhamnus cathartica (buckthorn). For example, for sharp purgation:

℞ Tincturæ jalapæ compositæ (N. F.) .... 12 c.c. (f℥iij);
Syrupi rhamni catharticæ (N. F.) .... 20 c.c. (f℥v). —M.

Purgative Enemas.

℞ Infusi sennæ (2 per cent.) .... 8 c.c. (f℥ij);
Magnesii vel sodii sulphatis .... 30 grams (℥j);
Decocti altheæ .... 300 c.c. (f℥x).
F. s. a.
Sig.: For an enema, to be taken warm and retained.

℞ Sodii sulphatis .... 15 grams (℥ss);
Sennæ .... 10 grams (ʒiiss);
Mellis .... 40 c.c. (f℥x);
Aquæ bullientis .... 450 c.c. (Oj).
Ft. decoct. leviss., cola, et exprime.
Sig.: For an enema, to be retained.

Miscellaneous Preparations.—TEAS.—The following formula is given in *Revue française de médecine et de chirurgie* (No. 6, 1905), as that of the "tisane du curé de Deuil" (the curate of Deuil's tea):

Powder No. 1.

℞ Altheæ radicis,
Rumicis radicis,
Tritici radicis,
Glycyrrhizæ ....āā 15 grams (℥ss);
Cichorii Intybi foliorum .... 7 grams (gr. c).
Boil for 10 minutes in 2 liters (quarts) of water, and add:

Powder No. 2.

Rhei sinensis contriti,
Sodii sulphatis ....āā 4 grams (ʒj).
Infuse the whole for two hours and strain,
To be taken in the morning in two or three days' time, according to effect.

COMPOTES, MARMALADES, AND PRESERVES.—A good preparation may be made by cooking with prunes or apples a few senna pods and some buckthorn bark (frangula) enclosed in a little muslin sac. The prune juice or apple marmalade thus obtained exhibits very marked laxative properties. Its laxative action may be further enhanced by sweetening it with honey or manna. One might even incorporate agar-agar in it.

Hypodermic Injection of Purgatives.*—A purgative or laxative action can be obtained by hypodermic use of a large number of therapeutic agents.

The doses of the cathartics to be thus given are much smaller than by the oral route. Thus, with sodium or magnesium sulphate, having obtained a laxative effect with doses of a few centigrams and a purgative effect with doses of a few decigrams—*i.e.*, with doses about 100 times less than those used by mouth—Carnot employs 1 per cent. solutions of these salts, of which he injects 2 to 20 c.c. (30 to 320 minims); one may, however, instead use 10 per cent. solutions, injecting 1 to 3 c.c. (16 to 48 minims).

In the case of senna, a sterilized solution is used—1 c.c. (16 minims) of a 5 per cent. solution or 5 c.c. (80 minims) of a 1 per cent. solution. The same applies to cascara sagrada and frangula. In the case of phenolphthalein, a sodic solution has to be used in order to effect solution of the drug.

* After CARNOT, *Paris méd.*, June 29, 1912.

CATHARTICS.

	PREPARATIONS.	MAXIMUM DOSES.		PHARMACOLOGIC ACTION.	CLINICAL INDICATIONS.	CONTRA-INDICATIONS	REMARKS.
		Single.	*Daily.*				
		Mechanically Acting Cathartics.					
Linseed.	As such.	Teaspoonfuls, *ad libitum.*		Foreign body.	*Mild chronic constipation.*	**Acute appendicitis and peritonitis contraindicate all purgatives.**	
Charcoal.	As such, granulated or in capsules.	Teaspoonful.		Foreign body.	*Do.*		Particularly serviceable in conjunction with belladonna in chronic spastic constipation.
Castor Oil.	As such, or in capsules.	50 c.c.	50 c.c.	Lubricant; stimulant to muscle tissues.	*Simple evacuation.*	*None.*	
Agar-agar.	Strips or tablets.	*Ad libitum.*		Hygroscopic, increasing bulk and softening fecal masses.	*Chronic constipation, especially when spastic.*	—	
Liquid Petrolatum.	As such.	Teaspoonfuls, *ad libitum.*		Stercoro-intestinal lubricant.	*Mucomembranous enterocolitis.*	—	
		Cholagogues.					
Oxgall (extract).	Pills.			Cholagogue, stimulating bile secretion.	*Intestinal antisepsis. Gastro-hepatic disorders.*	—	

Calomel.	Powders, cachets.	1 gram.	1 gram.	Intestinal antiseptic. Diuretic.	*Intestinal infections in children.* *Heart weakness and uremia.* *Dysentery (in conjunction with ipecac).*	—	It is always wise to avoid the chlorides, iodides, and bromides when giving calomel.
			Secretory Stimulants.				
SALINES. **Sodium sulphate.**	In natural (mineral waters) or artificial solution.	40 grams.		Exosmosis. Intestinal hypersecretion through reflex stimulation of the glands of Lieberkühn.	*Evacuation, in gastrointestinal upsets.*	*Extreme old age.* *Pronounced weakness.*	The *purgative mineral waters* embody mainly sodium sulphate together with various salts of magnesium and sodium chloride.
Magnesium sulphate.	Do.	60 grams.			*Elimination (where body fluids abnormal).*	—	Other *magnesium preparations:*
Magnesium citrate.	Do. *Liq. magn. citratis.*	60 grams.			*Derivative action (various states of congestion).*	—	Milk of magnesia: *Antacid,* laxative; 10 c.c.
Magnesium oxide.	Tablets, powders, cachets, granules, chocolate, etc.	15 grams.			*Depletion and cholagogue action (hepatic congestion, obesity, etc.).*	—	Magnesium carbonate: Same properties; 3 grams.
SACCHARINES. **Manna.**	Tablets, electuaries.	50 grams.			*For children.*	—	

CATHARTICS (*continued*).

	PREPARATIONS.	MAXIMUM DOSES. *Single.*	MAXIMUM DOSES. *Daily.*	PHARMACOLOGIC ACTION.	CLINICAL INDICATIONS.	CONTRA-INDICATIONS	REMARKS.
Muscular Stimulants.							
ANTISPASMODICS.							In general, all *cathartics are contraindicated*, particularly the drastics, in *appendicitis*, peritonitis, volvulus, and internal or external strangulations.
Belladonna.	Powder (pills). Extract (pills). Tincture (10%).	0.15 gram 0.03 " 1 c.c.	0.5 gram 0.1 " 4 c.c.	Antispasmodic.	*Combined with the drastics or mechanically acting cathartics in habitual spastic constipation.*	—	
STIMULANTS.							
Nux vomica.	Strychnine (pills, solution). Tincture (10%).	0.005 gram. 1 c.c.	0.015 gram. 5 c.c.	Stimulant to muscle.		—	
Vegetable Cathartics, Including Drastics.							
WEAK CHOLAGOGUES.							1. The *cathartics* that are *insoluble in water* (calomel, phenolphthalein, vegetable cathartics and drastics, etc.) should, for *children*, be prescribed in suspension in milk, in a flavored mucilage, or incorporated in honey, preserves, chocolate, or cookies.
Cascara sagrada.	Powder (pills, tablets, cachets). Extract (pills). Fluidextract (liquid preparation, elixir).	1 gram 0.3 " 1 c.c.	2 grams 0.6 " 2 c.c.	Increased intestinal secretion. Cholagogue action.	*Habitual constipation, atonic or spastic.*	—	
Rhubarb.	Powder (pills, tablets, cachets). Extract (pills). Tincture.	1 gram 0.5 " 5 c.c.	5 grams 1 " 15 c.c.	Stimulant to peristalsis.	*Habitual congestion of the liver.*	—	
Podophyllum.	Resin (podophyllin).	0.03 gram	0.1 gram			—	[Caution with euonymus to avoid accumulation.—N. F.]
Euonymus.	Extract (N. F.).	0.1 "	0.3 "			—	

POWERFULLY ACTIVE						2. The *drastics* afford the time-honored and proven active constituents of countless cathartic preparations, chiefly pills.
Aloe.	Powder (pills, cachets). Extract (pills). Tincture.	0.25 gram 0.12 " 2.5 c.c.	0.5 gram 0.25 " 10 c.c.	Same effects as with the preceding, but more severe.	*Same indications as above.* *Various states of congestion (hepatic, cerebral, pulmonary).* *Uremia.*	*Hemorrhoids.* *Pregnancy.* *Uterine congestion.*	
Scammony (Ipomœa, U. S. P., Mexican scammony).	Powder (pills, cachets, cookies, chocolate). Resin (pills, cachets).	0.5 gram 0.25 gram	1 gram 1 gram				
Jalap.	Powder. Resin. Compound tincture. Compound powder (N. F.).	1 " 0.2 " 25 c.c. 2 grams	2 grams 0.5 " 25 c.c. 4 grams				
Croton Oil.	In olive oil, electuaries, or soap pills.	0.05 c.c. 1 to 2	0.1 c.c. drops.	The most severe of the drastics.	*Severe cerebral or pulmonary congestion.*	—	The violence of the action of croton oil demands care in its use and introduces an element of risk. It should be avoided by those inexperienced in its use.
Senna.	Particularly used in enemas.	10 to 15 grams in 300 to 500 c.c. of water.		Peristaltic stimulation of large bowel.	*Various congestive states.*	*Proctitis.* *Hemorrhoids.*	
Synthetic Cathartics.						
Phenolphthalein.	Tablets, pills, cachets; insoluble in water.	0.15 gram	0.5 gram	Stimulant to secretion with localized action on intestinal glands.	*Habitual constipation.*	—	
Hypodermic Cathartics.						
Magnesium sulphate.	One per cent. solution.	2 to 20 c.c. in hypodermic injections.		—	—	—	Method not yet thoroughly investigated. Caution required.
Senna.	One per cent. solution.	2 to 5 c.c. hypodermically.					

While the local (pain, redness) or constitutional (fever, chills) reactions are inconstant and of little account, one should nevertheless bear in mind the possibility of their occurrence and beware of the as yet but slightly known disturbances which the hypodermic introduction of such compounds may produce.

One might prescribe:

(1) Magnesium sulphate solution (1%) ...... 100 c.c. (3 fluidounces).
To be sterilized.

Dose, 2 to 20 c.c. (32 to 320 minims) according to *indications* and *results*.

The indications are *spastic constipation; lead colic* with painful contraction of the bowel; cases of *vomiting, intoxication, coma,* and *ulcerative gastric lesions.*

(2) Senna solution (1%) .... 50 c.c. (1½ fluidounces).
To be sterilized.

Dose, 2 to 5 c.c. (32 to 80 minims) according to *indications* and *results*.

The indications are *atonic, flaccid constipation,* habitual or casual (post-operative or post-anesthetic, through intestinal paresis).

C.—EMETICS.

An emetic action is exerted:

Either directly on the emetic center in the medulla. This is true of **apomorphine,** of which 0.005 to 0.01 gram ($\frac{1}{12}$ to $\frac{1}{6}$ grain) injected hypodermically will bring on nausea and vomiting in a few minutes. By the gastric route, even distinctly larger doses exert only an uncertain and much slower action (20 to 30 minutes). No other conclusion is permissible than that apomorphine, after its absorption into the blood, travels up to exert its action on the vomiting center, whereas its action on the gastric mucous membrane is slight or *nil.*

Or indirectly in a reflex manner. This applies to **ipecacuanha** and to **tartar emetic,** the action of which is more certain, more intense and more rapid by the oral route than by the hypodermic route.

The prodromal stage of vomiting is represented by nausea; the milder grade of nausea is accompanied by a general hypersecretion (cutaneous, salivary, bronchial, etc.) and, perhaps, by a lowering of bronchial tone, which makes of the emetics in small doses excellent expectorants.

The Montpellier school has made a particularly thorough study of the clinical and physiopathologic action of the emetics, and recognizes 4 distinct periods in it, *viz.,* the expectorant, nauseant, emetic, and contrastimulant periods. Upon giving a dose which exceeds the emetic dose, tolerance is manifested, no vomiting is obtained, and there is produced a "contrastimulant" effect concerning which Grasset expresses himself thus: "In this period, the vomiting is no longer

produced and the dominant effect is the action on the striped muscles and the heart in particular. Indeed, previous weakness of the patient under treatment may result in the development with a small dose of the effects of a larger dose. In an exhausted person, tolerance may be established at once with moderate doses. This is the reason, says Gubler, why it is impossible to obtain vomiting with tartar emetic or with copper sulphate or any other emetic in secondary pneumonia complicating typhoid fever of unfavorable type or in the adynamic period of a suppurative peripneumonitis." From this viewpoint the emetics, Trousseau was wont to say, constitute a powerful antiphlogistic measure which can be substituted for blood-letting with great advantage. The actual result, states Grasset, however, is rather a weakening, contrastimulant action. At the present time we would call it a *vagotonic* effect.

The frequently remarkable action of the emetics—of ipecacuanha and emetine, in particular—in hemoptysis due to pulmonary congestion constitutes, at all events, an interesting application of this property.

* * *

The **three time-honored emetics** are ipecacuanha, tartar emetic, and apomorphine, and the first of these is by far the most commonly used.

IPECACUANHA, consisting of the root of various emetic plants of the family Rubiaceæ (especially *Cephælis ipecacuanha*), was imported from Brazil in the sixteenth century and was at first used in dysentery and other diarrheic disorders. Its emetic properties were studied only later, by Gohl. Its alkaloid *emetine* was isolated by Pelletier and Magendie (1817-1823).

Ipecac is used in small, fractional doses of 0.05 to 0.3 gram (¾ to 5 grains) as an expectorant and to reduce congestion and lower temperature in bronchitis, congestion of the lungs, and hemoptysis.

Formerly a standard remedy in dysentery in doses averaging 0.5 to 1 gram (7½ to 15 grains), given by enema and by the mouth, it has been largely supplanted, since the initial investigation of Rogers (1912), by its alkaloid emetine.

In large doses, such as 1 to 2 grams (15 to 30 grains), it is the most commonly used emetic, being employed in gastro-intestinal upsets, intoxications, and bronchial congestion in robust subjects.

MODES OF ADMINISTRATION.

Ipecac is used in powder form or in a syrup or other liquid preparation. It is a constituent of the well-known Dover's powder.

Powdered ipecac is given in suspension in water or syrup, or in pills or troches (0.01 gram—1/6 grain) in the case of small doses.

In doses of 0.02 to 0.05 gram (1/3 to 3/4 grain) it acts as a stimulant to gastric motility and secretion;

In doses of 0.05 to 0.5 gram (3/4 to 7½ grains), as expectorant and liquefier of bronchial secretions, and

In doses of 0.5 to 2 grams (7½ to 30 grains), as an emetic.

The emetic dose for children is 0.1 gram (1½ grains) per year of age.

Syrup of ipecac, especially serviceable in children [*Syrupi ipecacuanhæ,* U. S. P.; expectorant dose, 0.75 c.c. (12 minims); emetic dose, 15 c.c. (4 fluidrams)]. The emetic dose for children is 2.5 c.c. (40 minims) per year of age.

PILLS:

(*a*) *Expectorant:*

℞ Ipecacuanhæ pulveris,
Sodii benzoatis,
Terpini hydratis,
Quininæ benzoatis ....āā 0.05 gram (gr. 3/4).
Ft. pil. No. i. Da tal. No. xx.
Sig.: Four to six pills a day. (For *bronchitis in grippe.*)

(*b*) *Segond's antidysenteric pills:*

℞ Ipecacuanhæ pulveris .... 0.05 gram (gr. 3/4);
Hydrargyri chloridi mitis .... 0.02 gram (gr. 1/3);
Extracti opii (N. F.) .... 0.01 gram (gr. 1/6).
Mellis .... q. s.
Ft. pil. No. i. Da tal. No. xl.
Sig.: Six to ten pills a day.

(*c*) ℞ Ipecacuanhæ pulveris .... 0.05 gram (gr. 3/4);
Extracti opii (N. F.) .... 0.01 gram (gr. 1/6);
Digitalis pulveris .... 0.02 gram (gr. 1/3).
Ft. pil. No. i. Da tal. No. x.
Sig.: One pill every ten minutes. (In *hemoptysis.*)

POWDERS:

(*a*) ℞ Ipecacuanhæ .... 1.5 grams (gr. xxiij).
Div. in chart. No. ii.
Sig.: Powders to be taken ten minutes apart in a little water sweetened with sugar.

(*b*) *Dover's powder.*

The French official Dover's powder is formulated thus:

℞ Ipecacuanhæ pulveris,
Opii ....āā 10 grams (ʒiiss);
Potassii nitratis,
Potassii sulphatis ....āā 40 grams (ʒx). —M.

This preparation is diaphoretic, decongestive, calmative, expectorant and diuretic. It is prescribed in powders, pills, cachets, liquid preparations, etc., in average daily amounts of 0.2 to 1 gram (3 to 15 grains).

[In *Pulvis ipecacuanhæ et opii*, U. S. P., the potassium salts of the above formula are replaced by milk sugar. Average dose, 0.5 gram (7½ grains).]

CACHETS:

(*a*) ℞ Ipecacuanhæ pulveris .... 0.01 gram (gr. ⅙);
Potassii sulphatis,
Potassii nitratis ....āā 0.05 gram (gr. ¾);
Sodii bicarbonatis .... 0.3 gram (gr. v).

Pone in cachet. No. i. Da tal. No. xxx.
Sig.: One before each meal. (For *deficient gastric secretion.*) (ROBIN.)

(*b*) ℞ Pulveris ipecacuanhæ et opii,
Terpini hydratis ....āā 0.1 gram (gr. iss);
Sodii benzoatis,
Quininæ dihydrochloridi ....āā 0.25 gram (gr. iv).

Pone in cachet. No. i. Da tal. No. xx.
Sig.: Three or four a day. (For *grippe with bronchitis and congestion.*)

LIQUID PREPARATIONS:

(*a*) ℞ Sodii benzoatis .... 0.5 gram (gr. viiss);
Infusi ipecacuanhæ (0.3 gram—gr. v) .... 60 c.c. (f℥ij);
Syrupi .... 30 c.c. (f℥j).

M. Sig.: To be taken in teaspoonful doses in one, two, or three days, according to age. (For acute *bronchitis in children.*)

(*b*) ℞ Ipecacuanhæ pulveris .... 2-3 grams (gr. xxx-xlv);
Syrupi ipecacuanhæ .... 20 c.c. (fʒv);
Extracti opii .... 0.03 gram (gr. ss);
Syrupi .... 55 c.c. (f℥ij);
Syrupi aurantii corticis .... 30 c.c. (f℥j).

M. Sig.: One tablespoonful every hour. (For *hemoptysis.*) (LYON and LOISEAU.)

(*c*) The French official *compound syrup of ipecac* ("sirop Desessartz") has the following lengthy formula:

℞ Ipecacuanhæ pulveris,
Serpylli ....āā 3 grams (gr. xlv);
Sennæ,
Papaveris rhœadis,
Magnesii sulphatis ....āā 10 grams (ʒiiss);
Vini albi,
Aquæ aurantii florum ....āā 75 grams (f℥iiss);
Aquæ bulliatæ .... 300 grams (f℥x).
Sacchari albi .... q. s. —M.

This preparation contains approximately 0.1 gram (1½ grains) of ipecac in each tablespoonful. It is prescribed as expectorant in teaspoonful doses in children and in tablespoonfuls in adults.

EMETINE [$C_{15}H_{22}NO_2$], the alkaloidal active principle of ipecac isolated, as already noted, by Pelletier and Magendie about 1820, shares the emetic and antidysenteric properties of ipecac. Overlooked in its clinical bearing until 1912, it has since gained an abrupt and wide renown. It was the original communication of Rogers, of Calcutta, that revealed the value of emetine to the clinician. In France, Chauffard in particular made a study of it.

After first receiving recognition as a practically specific remedy for amebic dysentery, its hemostatic properties led to its employment in hemoptysis, and its antiseptic properties, in pneumonia and Asiatic cholera.

By the hypodermic route, a dose as high as 0.2 to 0.25 gram (3 to 3¾ grains) may be given in a single injection, but in continuous treatment, 0.15 gram (2¼ grains) a day should never be exceeded.

Any risk entailed in administering emetine seems, however, to attach mainly to its property of accumulating in the system. It can be found in the urine sixty days after cessation of the treatment. As soon as 1 gram (15 grains) of emetine has been reached by addition of the daily doses, one meets almost constantly with severe and more or less lasting disturbances which constitute the precursory signs of fatal emetine poisoning. These signs begin with general asthenia with neuralgic pains and cramps, dyspnea on exertion, rapid pulse, and low blood-pressure; next there appears muscular paresis (wobbling head, trismus, and difficulties in swallowing, mastication and speech), accompanied by diminution of the reflexes. Soon dyspnea is present even during rest, heart weakness becomes more marked, the pulse becomes soft and easily compressible, and the patient loses weight and passes into cachexia. From this time on there are manifest the evidences of established poisoning, which is always fatal: Loss of reflexes, arhythmia, hiccup, labored inspiration, uncountable pulse, and signs of renal insufficiency.

In conclusion, it seems that the precautionary recommendations of Chauffard should be heeded in order to avoid untoward results. The "wobbling head" sign [paresis of neck muscles] appears to be one of those which should direct the observer's attention to the imminence of the danger that is being run by the patient under treatment.

Emetine occurs as a white, crystalline powder, with a bitter taste, soluble in 10 parts of cold water, and combining readily with acids [*Emetinæ hydrochloridum,* U. S. P., average dose, 0.02 gram (⅓ grain).]

Old solutions of it deteriorate and should be discarded. The purity of the solutions of emetine hydrochloride used is of great

importance, and standard chemical tests of the compound are very desirable.

The mode of administration to be preferred is the subcutaneous route. The intramuscular route is to be avoided as painful, the intravenous route as dangerous, the rectal route as unsatisfactory (intestinal intolerance, reactivation of dysentery), and the oral route as inadequate.

The *serviceable, necessary and sufficient doses* are, according to Chauffard:

In *amebic dysentery,* in which emetine acts after the manner of a specific: 0.06 to 0.1 gram (1 to 1½ grains) a day, divided into two doses, in series of six to eight days, with average intervening periods of two weeks.

In *hemoptysis,* in which emetine acts after the manner of a depressant: 0.04 to 0.06 gram (⅔ to 1 grain).

TARTAR EMETIC, or antimony and potassium tartrate,



$$COOH - CHOH - CHO\,(SbO) - COOK + \tfrac{1}{2}\,H_2O,$$

supplied ample material for an apologetic literature in the seventeenth century. The "antimony quarrel," the official excommunication of tartar emetic by the Faculty of Medicine of Paris at the instigation of Guy Patin, are unsavory memories which are nevertheless occasionally worth recalling. Tartar emetic in truth deserved "neither that exaggerated honor, nor those indignities"; it is a powerful emetic agent, emeto-cathartic in large doses, and rather forsaken at the present time. It may be given by the mouth in doses of 0.05 to 0.15 gram (¾ to 2¼ grains) in solution in plain or flavored water, or in some infusion. Thus:

(*a*) ℞ Antimonii et potassii tartratis ...... 0.05-0.15 gram (gr. ¾-ii¼).
Div. in chart. No. iii.
Sig.: Powders to be taken ten minutes apart in water or a cupful of some infusion.

(*b*) ℞ Antimonii et potassii tartratis .... 0.05 gram (gr. ¾);
Ipecacuanhæ pulveris .... 1.5 grams (gr. xxiij).
Div. in chart. No. iii.
Sig.: Powders to be taken ten minutes apart in a glass of lukewarm water.

This distinctly weakening medication should be avoided in debilitated subjects, in children, and in the aged.

* * *

The use of tartar emetic has been advocated by many colonial writers (Mesnil and Brimont, Manson, Christopherson, Brault, Viarma, Arago, Apert, and Hérisson) for the treatment of yaws,

bilharziasis, malaria, filariasis, and the hepatic distomiasis of the Far East.

These observers have recommended its administration by intramuscular or intravenous injections.

In the last-named procedure, which seems to be more active and more easily applied than the former, a 1 per cent. solution of tartar emetic in physiologic salt solution, sterilized at 100° C. and not in the autoclave, is used. A dose of 0.05 to 0.1 gram (¾ to 1½ grains) a day is given on ten consecutive days, or better, every three days up to ten injections.

The reactions, generally mild, are either immediate (dizziness, nausea, dry cough) or delayed (hiccup, lassitude, weakness). They are uncommon and of slight severity.

The results are generally prompt, especially in bilharziasis of the bladder, in which parasitologic control is easier. The urine clears up. The ova, which continue to be passed for a time longer, are distorted and incapable of development. Similar results have been noted in rectal bilharziasis.

APOMORPHINE ($C_{17}H_{17}NO_2$) is morphine ($C_{17}H_{19}NO_3$) minus H_2O. It is formed spontaneously in old solutions of morphine or by the action of sulphuric acid, acting as a powerful dehydrating agent, on morphine. Its emetic properties were well demonstrated by Vulpian and his pupils.

It is a powerful emetic, the use of which is largely limited to cases of poisoning, and which is given *exclusively by the hypodermic route* in doses of 0.005 to 0.015 gram (1/12 to ¼ grain). Thus:

℞ Apomorphinæ hydrochloridi .... 0.01 gram (gr. ⅙);
Aquæ destillatæ .... 5 c.c. (♏ lxxx).
Sterilisa.

Of this solution from 2 to 5 c.c. (30 to 75 minims) may be administered hypodermically as emetic.

V

DRUGS ACTING ON THE NERVOUS SYSTEM.

I.—NERVOUS DEPRESSANTS.

A.—ANTISPASMODICS.

BELLADONNA. *Atropa belladonna* (Solanaceæ).—Belladonna is one of those outstanding substances in the Pharmacopœia which, like opium, digitalis and the salicylates, is used all the oftener, the more one knows of its action. It improves on acquaintance; of how many drugs and persons can the same be said?

Its pharmacologic actions and manifold applications appear to depend upon a practically specific selective action on the autonomic nervous system (sympathetic and parasympathetic). It acts as a stimulant to the sympathetic in its mydriatic and cardio-accelerator effects.* But like many other substances, belladonna attacks different points in its action on the neurons; according to the dose used and the time relations, it acts (1) as a stimulant to the central nervous system and medulla oblongata; (2) as a stimulant to the sympathetic and depressant to the pneumogastric. Small doses produce central stimulation; larger doses produce peripheral paralyzing effects.

The difficulty met with in summarizing precisely the pharmacologic action of belladonna (and of atropine) results from the fact that the effect observed differs according to the dose, the apparatus employed, and the stage of the drug's action. Petzetakis, who has made a very painstaking study of the action of atropine on the vagi and heart-action, condenses the results of his observations as follows:

"**The Stage of Stimulation in the Action of Atropine.**—The action of atropine might, therefore, be summarized thus:

* This statement is not in agreement with current teachings in this country, which are to the effect that no direct stimulation of the sympathetic is produced by atropine. According to Sollmann it is probable, however, that the natural sympathetic tone is heightened when the constrictor tone (with reference to the pupil) is withdrawn through the paralysis of the oculomotor (parasympathetic) endings in the iris by atropine.—Tr.

A.—INITIAL STAGE OR STAGE OF STIMULATION.

Period	Manifestation
I. Period of hyperirritability of the vagi.	*Manifested* in slowing of the rate and various disturbances of cardiac rhythm. *Demonstrated* by increased irritability of the vagus, direct or reflex.
II. Period of hyperirritability of the vagi. Probable direct accelerator action on the sinus center or the cardiac ganglia.	*Manifested* in a slight total acceleration above the normal rate. *Demonstrated* by increased irritability of the vagus, direct or reflex.

B.—LATE STAGE OR STAGE OF PARALYSIS.

Period	Manifestation
Period of paralysis of the inhibitory components of the vagi.	*Manifested* in a pronounced acceleration. *Demonstrated* by loss of irritability of the vagi, direct or reflex.

"To sum up, from all this aggregate of facts *one must conclude that atropine at the beginning of its action causes an increase in the irritability of the cardioinhibitory components of the vagus.* One might say that this increase is only apparent, for the effects of the changes of rhythm and, in general, of the slowing of the rate, might be accounted for also by a reduced irritability of the accelerators. *A number of features, however, in particular the study of the direct or reflex irritability of the vagi, allow us to conclude definitely in favor of an increased irritability of the cardioinhibitory components of the vagi.*"

The *action in the lungs and on the intestine* may be summarized thus:

Paralyzing action on the motor terminals of the vagi in the lungs (whence the treatment of asthma, by removal of the bronchial spasm); sometimes a paralyzing action on the motor terminals of the vagi in the intestine (whence the action on lead constipation, through removal of the bowel spasm); at other times a stimulant action on the plexuses of Auerbach (whence the action in atonic constipation, through stimulation of the intestinal musculature.)

It is not as yet possible to gather these complex actions into a brief but sufficiently comprehensive formula. For the present it is best to stand on the solid ground of clinical therapeutics.

Belladonna acts as:

Antispasmodic and in a certain degree as an analgesic. This is the action which confers upon it its most numerous indications:

1. *Spasm* of the anus, vagina, bladder or ureter.
2. *Painful conditions of the colicky type:* Gastralgia, hepatic colic, renal colic, uterine colic, etc.

3. *Convulsive and spasmodic disorders:* Epilepsy, chorea, whooping-cough, laryngismus stridulus, etc.

4. *Chronic spastic constipation.*

5. *Rebellious vomiting,* reflex or from gastric intolerance.

6. *Bronchial spasm (asthma).*

Mydriatic, or dilator of the pupil. In this connection it is employed in cases of *iritis with a tendency to synechiæ* and in *cyclitis and iridocyclitis* (with caution); it is sometimes used in cataract, and is serviceable in many processes involving the cornea.

It is formally contraindicated when the intraocular tension is increased. It should be completely avoided in all glaucomatous conditions and in deep ulcerations of the cornea.

Hypocrinic, or arrester of the salivary, gastric, pancreatic, and sweat secretions, and to some extent also of the intestinal secretions. On this basis, belladonna is indicated in *sialorrhea,* in *painful gastric hypersecretion,* and especially in profuse and exhausting *morbid sweats.*

Among other special uses may be mentioned those relating to *muscarine* (toadstool) *poisoning, poisoning by aconite,* and the preventive injections of atropine and morphine against the danger of syncope in chloroform narcosis:

℞ Morphinæ hydrochloridi .... 0.1 gram (gr. iss);
Atropinæ sulphatis .... 0.02 gram (gr. 1/3);
Aquæ destillatæ .... 10 c.c. (f℥iiss).

S. Sig.: One-half to one c.c. (8 to 16 minims) one-half hour before the administration of chloroform.

Belladonna Substitutes.

Hyoscyamus and **Stramonium** (*Datura stramonium*), of the natural order Solanaceæ, are drugs allied to belladonna, and have been used in conjunction with it in various anodyne ointments as well as in various powders and cigarettes intended for use in bronchial asthma.

Hyoscyamus (*Hyoscyamus niger*) is a commonly used drug, and is prescribed under much the same circumstances as belladonna, either in the form of a powder, extract, fluidextract, or tincture. The doses of the hyoscyamus preparations are considerably larger than those of the corresponding preparations of belladonna, on account of the difference in the total alkaloidal content [0.065 per cent. being the alkaloidal requirement of the U. S. P. for hyoscyamus, as against 0.3 per cent. in belladonna leaves and 0.45 per cent. in belladonna root].

[*Hyoscyamus,* U. S. P., average dose, 0.2 gram (3 grains).
Extractum hyoscyami, U. S. P., 0.05 gram (5/6 grain).
Fluidextractum hyoscyami, U. S. P., 0.2 c.c. (3 minims).
Tinctura hyoscyami, U. S. P., 10 per cent., 2 c.c. (30 minims)].

BELLADONNA.

PREPARATIONS.	MODES OF ADMINISTRATION.	MAXIMUM DOSES.		PHARMACOLOGIC ACTION.	INDICATIONS.	REMARKS.
		Single.	*Daily.*			
			Belladonna.			
Powdered leaves.	Pills. Powders for asthma.	0.15 gram	0.5 gram	(1) *Antispasmodic.* *Analgesic.*	**Painful spasms.** *Gastro-intestinal pains.* *Various forms of colic.*	—
Extract.	Pills. Liquid preparations. Ointments. Suppositories.	0.03 gram	0.1 gram	(2) *Hypocrinic* (checking sweats).	**Constipation.** *Intestinal occlusion.* *Mucous enterocolitis.*	—
Tincture.	Liquid preparations.	1 c.c.	4 c.c.	(3) *Mydriatic.*	**Asthmatic states.** *Chorea.* *Eclampsia.* *Epilepsy.*	—
Fluidextracts.	Liquid preparations.	0.1 c.c.	0.35 c.c.	(4) *Analgesic, anti-spasmodic.*		
Syrup (French Codex).	Ten per cent. of tincture.	10 c.c.	40 c.c.		**Whooping-cough.** *Laryngismus stridulus.* *Sweats.* *Diarrhea.* *Ptyalism.* *Gastric hypersecretion.*	—
Ointment.	Ten per cent. of extract. Used externally.	—	—	—	*Superficial neuralgias.*	—
Plaster.	0.25 to 0.3 per cent. of alkaloids. Used externally.	—	—	—	*Abdominal pain.*	—

Liniment (N. F.)	Camphor, 5, in fluid-extract, to make 100. Used externally.	—	—	—		High alkaloidal content to be borne in mind.
			Atropine.			
Atropine.	Solution. Granules.	0.0005 gram	0.001 gram	Same indications as belladonna.	*Iritis.* *Keratitis with photophobia.* *Corneal perforation.*	Contraindicated in glaucoma. Increased intraocular tension.
Atropine sulphate.	Solution. Granules. Collyrium.	0.001 gram	0.002 gram	Much used in ophthalmology as mydriatic.	*Cataract.*	—

Characteristic Symptoms of Belladonna Poisoning.—In administering atropine or belladonna, the practitioner should always be on the watch for the appearance of the cardinal manifestations of belladonna intoxication, to wit:

1. Paralysis of the salivary nerves, manifested in *dryness of the mucous membranes,* in particular those *of the mouth and tongue.*

2. Paralysis of the intraocular oculomotor distribution, manifested in *dilatation of the pupils, generally pronounced,* and disturbance of vision.

3. Paralysis of the inhibitory fibers of the vagus nerve, manifested in *increase of the heart-rate.*

4. Paralysis of the peripheral vasomotors, manifested in *extreme dryness of the skin* and sometimes by the appearance of an actual erythema.

Finally, recollecting the stimulating action of the drug on the nerve centers and its paralyzing action on the peripheral nerves, one should regard with suspicion any condition of *delirium* characterized by unusual cerebral activity, restlessness, hyperideation (due to stimulation of the nerve centers), and difficulty, languor and sluggishness of motion (due to paralysis of the peripheral nerves).

In using belladonna, let us endeavor to prescribe neither too much nor too little of it, and let us "keep our eyes open" while our patients are under the influence of this drug.

The maximum dose of [U. S. P.] hyoscyamus powder is 0.4 gram (6 grains); of the extract, 0.2 gram (3 grains); of the fluidextract, 0.4 c.c. (6 minims), and of the tincture, 4 c.c. (1 fluidram).

Hyoscyamine is the alkaloid of hyoscyamus [and of other plants of the Solanaceæ].

[*Hyoscyaminæ hydrobromidum,* U. S. P., average dose, 0.0006 gram (1/100 grain).]

MODES OF ADMINISTRATION OF BELLADONNA AND ATROPINE.

I. Belladonna.

1. Pills.—In the case of the powdered leaves, one may subscribe to Comby's recommendation to give 0.005 to 0.01 gram (1/12 to 1/6 grain) a day and per year of the child's age. As for the *extract,* in the adult the following dosage may be followed: 0.01 to 0.03 gram (1/6 to 1/2 grain) at a dose, and 0.03 to 0.1 gram (1/2 to 1 1/2 grains) in the twenty-four hours. *Trousseau's laxative pills* are based on belladonna extract and powder:

℞ Extracti belladonnæ,
Belladonnæ foliorum pulveris .... āā 0.01 gram (gr. 1/6).
Ft. pil. No. i. Da tal. No. xii.
Sig.: One to three pills before retiring.

2. Drops and Mixtures.—Of the *tincture,* five *drops* per year of age may be considered the full dose; by dividing the doses and gradually increasing them, however, much larger amounts may be reached, such as, for the adult, 4 c.c. (65 minims), and it should be noted that, to obtain a therapeutic effect, the drug often has to be pushed to the point of appearance of "physiologic symptoms," such as mydriasis, dry skin and mucous membranes, etc.

Belladonna is sometimes combined with aconite in the treatment of *cough* or of *pertussis* or any *refractory cough of paroxysmal type:*

℞ Tincturæ belladonnæ,
Tincturæ aconiti,
Tincturæ grindeliæ,
Tincturæ droseræ,
Tincturæ opii camphoratæ,
Aquæ laurocerasi .... āā 2 c.c. (f℥ss).
M. Sig.: Five to ten *drops* three or four times daily; increase each successive dose by one drop to effect.

In similar cases with *heart weakness in addition:*

℞ Tincturæ belladonnæ .... 10 c.c. (f℥iiss);
Tincturæ valerianæ,
Tincturæ digitalis .... āā 5 c.c. (♏lxxx).
M. Sig.: Ten to 100 *drops* a day, the increase being gradual and under supervision.

For *gastric and intestinal pain* one may prescribe:

℞ Tincturæ belladonnæ,
Tincturæ cinnamomi (N. F.),
Tincturæ calumbæ ....āā 5 c.c. (♏lxxx);
Tincturæ opii camphoratæ .... 15 c.c. (f℥iv).
M. Sig.: Thirty to eighty *drops* in one-fourth glassful of water sweetened with sugar.

3. Syrup.—Trousseau prescribed the following syrup in *whooping-cough:*

℞ Syrupi belladonnæ (1 per cent.),
Syrupi opii (0.1 per cent.),
Syrupi ætheris (2 per cent.),
Syrupi aurantii florum ....āā 15 c.c. (f℥ss).
M. Sig.: Teaspoonful doses, according to tolerance.

The French official belladonna syrup contains one-tenth of its weight of tincture of belladonna; it is thus a highly active preparation. If the initial dose of the tincture per year of age be taken as 5 drops, the average daily dose of the syrup may be put down as about 2 teaspoonfuls for every three years of age. In view of its relatively great strength, this syrup is prescribed only when diluted with some other syrup, and the mixture taken in teaspoonful amounts.

4. Powder and Cigarettes for Asthma.—*Belladonna leaves* form part of most of the anti-asthmatic powders:

℞ Opii pulveris .... 1 gram (gr. xv);
Potassii nitratis .... 5 grams (gr. lxxv);
Tincturæ benzoini .... 10 c.c. (f℥iiss);
Stramonii .... 25 grams (℥vj);
Belladonnæ foliorum .... 50 grams (℥iss).
M. Sig.: To be burned. One teaspoonful.

℞ Belladonnæ foliorum .... 10 grams (℥iiss);
Salviæ foliorum .... 15 grams (℥ss);
Stramonii .... 20 grams (℥v).
For 20 cigarettes.

5. External Uses.—The official *ointment* may be used in the treatment of *abrasions, painful fissures,* etc. In children, symptoms of belladonna intoxication have been observed following application of the ointment over extensive abraded surfaces or merely after excessive rubbing-in of the ointment.

Belladonna *plaster* yields some results when applied over the epigastrium in some forms of gastralgia and of dyspepsia attended with pain.

The French official *poplar-bud ointment* ("onguent populéum") is composed of the leaves of belladonna, hyoscyamus, poppy and solanum nigrum, of each 1 part; poplar-buds (*Populi gemmæ,* N. F.), 8 parts; alcohol, 4 parts (by weight), and lard, 40 parts. It is used in the treatment of hemorrhoids.

Lastly, the *extract* may be incorporated in suppositories, rectal or vaginal, for the treatment of intestinal, vaginal, or uterine affections.

℞ Extracti belladonnæ .... 0.05 gram (gr. ¾);
Aloes .... 0.1 gram (gr. iss);
Olei theobromatis .... 3 grams (gr. xlv).
Ft. suppos. No. i. (For *constipation.*)

℞ Extracti belladonnæ .... 0.05-0.1 gram (gr. ¾-iss);
Glycerini .... q. s.
Ft. suppos. vagin. No. i. (For painful *metritis* and *cancer of the cervix.*)

II. **Atropine.**

1. Granules of 0.00025 to 0.0005 gram (1/260 to 1/130 grain).

2. Solutions:

(*a*) ℞ Atropinæ sulphatis .... 0.01 gram (gr. 1/6);
Aquæ destillatæ .... 10 c.c. (f℥iiss).
S. Sig.: Ten to twenty drops (with standard dropper) a day, divided into three doses.

(*b*) ℞ Atropinæ sulphatis .... 0.01 gram (gr. 1/6);
Aquæ destillatæ .... 300 c.c. (f℥x).
S. Sig.: One to two tablespoonfuls a day.

For gastralgia and gastric hyperesthesia.

3. External Uses.—In *acute iritis,* a 0.5 per cent. collyrium of atropine sulphate may be employed, the instillations being, if necessary, repeated every three hours:

℞ Atropinæ sulphatis .... 0.05 gram (gr. ¾);
Aquæ destillatæ .... 10 c.c. (f℥iiss).
S. Sig.: Two drops to be instilled in the eye morning and evening.

If the pain is severe and the hypersensitive eye does not bear the instillation well, atropine may be applied by means of compresses.

℞ Atropinæ sulphatis .... 0.3 gram (gr. v);
Aquæ destillatæ .... 30 c.c. (f℥j).
S. Sig.: One teaspoonful in a (small) bowl of hot water. Compresses wrung out of hot water to be dipped in the bowl and applied over the eye.

III. **Combination of Opium with Belladonna.**—Much has been written on the combined use of opium and belladonna. There exists a certain antagonism between these two drugs in some of their physiologic effects. Thus, opium stimulates the vagus centers, whereas belladonna depresses them; opium depresses the respiratory center, while belladonna stimulates it; opium causes contraction of the pupil, belladonna dilatation; opium is diaphoretic, while belladonna checks the sweat secretion. *The two drugs are synergistic,* however, in certain other of their effects: Both stimulate at first and later depress

the nerve centers, the vasomotor centers and the sensory nerves. Opium and belladonna are thus only in part antagonists, and this partial antagonism may be availed of therapeutically, *e.g.*, to obviate certain untoward results of morphine administration without at the same time losing the useful effects. Thus, a combination of morphine and atropine is especially indicated in *renal* and *hepatic colic,* in which the two drugs act as synergists in relieving spasm, and in which, moreover, the combination seems to obviate the nausea that often results from the use of morphine alone. Dastre and Morhange have recommended the combination to *prevent untoward happenings in chloroform anesthesia.*

℞ Atropinæ sulphatis .... 0.01 gram (gr. 1/6);
Morphinæ hydrochloridi .... 0.1 gram (gr. iss);
Aquæ laurocerasi ....q. s. ad 10 c.c. (f℥iiss).—S.

One cubic centimeter (15 minims) of the above solution contains 0.01 gram (1/6 grain) of morphine hydrochloride and 0.001 gram (1/60 grain) of atropine sulphate.

In general, the opium and belladonna combination, which can be prescribed in various ways, is serviceable in the majority of *paroxysmal spasmodic disorders,* such as pylorospasm, spastic constipation, hepatic and renal colic, spasm of the larynx, cough, paroxysmal asthmatic dyspnea, angiospasm, angina pectoris, certain forms of paroxysmal tachycardia, uterine colic, etc. One might prescribe, accordingly:

℞ Pantopon .... 0.01 gram (gr. 1/6);
Atropinæ sulphatis .... 0.001 gram (gr. 1/60).
Ft. pil. vel ampul. No. i. Da tal. No. xii.
Sig.: One to three a day, according to indications.

Hyoscyamine versus Atropine.—In view of the fact that hyoscyamine is alone present in the living plants, Tiffeneau has advocated its substitution for atropine in therapeutics. In doing so, however, it is necessary to bear in mind that hyoscyamine is twice as active as atropine in its effects on the pupil and the vagus terminals. In ophthalmology, 0.25 or 0.2 per cent. solutions of hyoscyamine salts may be used in place of 0.5 or 0.4 per cent. solutions of atropine sulphate. Atropine and hyoscyamine are optical isomers, hyoscyamine being the levo-rotatory isomer, and atropine, the racemic product, *i.e.*, a combination in equal parts of levo- and dextro-hyoscyamine.

PAPAVERINE.—This opium alkaloid is relatively little employed, but some recent reports have redirected attention to it. It possesses the property of relaxing the muscles of various viscera (digestive canal, bladder, bronchi, uterus) and of the vessels. It may be used in all visceral and vascular spasms: Asthma, dysmenorrhea, pyloric and intestinal spasms, and angina pectoris. It may be prescribed in pills of 0.05 gram (3/4 grain)

each (2 to 5 a day), or injected subcutaneously, 0.03 to 0.05 gram (½ to ¾ grain).

BENZYL BENZOATE.—This is as active as papaverine, and less toxic. A 20 per cent. alcoholic solution of benzyl benzoate is used. The dosage is 20 to 40 drops 3 times a day before meals. This same dose may even be repeated at shorter intervals.

CALCIUM CHLORIDE.—Aside from its hemostatic, anti-anaphylactic and diuretic properties, calcium chloride possesses also an antispasmodic property. It may be given orally in doses of 2 to 4 grams (30 to 60 grains) or intravenously in a 1 or a 3 per cent. solution in doses of from 100 to 150 c.c. (3⅓ to 5 fluidounces) in the first instance and of 30 to 40 c.c. (1 to 1⅓ fluidounces) in the second, for one day or several days in succession. It has also been used in epilepsy, either in the intervals or in status epilepticus, intravenously; also in tetany, spasm of the glottis, laryngismus stridulus, infantile eclampsia, the diarrhea and vomiting of tuberculosis, and post-encephalitic states of rigidity.

B.—SEDATIVES.

BROMIDES.—The bromides, all containing bromine, possess a *generic, fundamental pharmacologic action typical of the whole group:*

They are **depressants to the neuromuscular system**; this action is exerted particularly on the centers, and leads to a *diminution of the sensory functions and of reflex action.* One must recognize, too, with Claude Bernard, that *potassium bromide acts primarily on the spinal cord and brain, and through the sympathetic on the circulation, including the heart.*

A clinical observation of some significance is that the action of the bromides is exerted in inverse ratio to the amount of chlorides in the diet taken at the time. It is manifested at its highest with the patient upon a chloride-free diet. Under these conditions it appears as if the bromide were becoming substituted for the sodium chloride present in the body and were passing into all cells alike. On this basis, the drug acts not only as a brain *sedative* or *calmative,* but also as a *hypnotic* through reduction of the sensitiveness to external stimuli.

The *secondary actions* of the bromides are dependent upon the metallic elements combined with them, which afford added useful properties.

Potassium bromide acts in particular as a depressant to the heart, constituting, therefore, a useful *cardiac sedative,* which is indicated in all cases of *cardiovascular erethism* (overacting hypertrophied heart, nervous arhythmias, cardiac neuroses, and the insomnia of heart cases). On the other hand, it is contraindicated in cases with heart weakness.

Sodium bromide acts but slightly or not at all on the circulation. It should, therefore, be given the preference in all cases in which the cardiopulmonary system is to be spared (asthma, urinary insufficiency, normal or weakened heart-action).

Strontium bromide, from the clinical standpoint, does not seem to possess any pronounced advantages over sodium bromide.

Ammonium bromide, a *neuromuscular depressant* like potassium bromide, has been claimed by some to act as a *diffusible stimulant,* stimulating the heart and respiration, and to be consequently indicated in the presence of spasmodic disorders, such as whooping-cough or reflex cough, coupled with a tendency to heart depression.

Monobromated camphor exerts a sedative action on the heart, a regularizing and quieting action on respiration, and some degree of depressant action in fever.

The bromides are especially indicated in all cases in which it is necessary **to allay abnormal irritability of the nervous system:**

1. *Conditions of nervous erethism with convulsive paroxysms,* foremost among which are *epilepsy* and the *epileptoid conditions* (if, indeed, an idiopathic epilepsy really exists), *eclampsia,* etc.

2. Cases of *nervous excitement* with *insomnia* or the *anxiety neurosis.*

3. *Delirium* of alcoholic, infectious, lead or maniacal origin, or of the congestive type with excitement. 4. *True migraine.*

5. The *spasmodic disorders* in general, including cardiac neuroses, whooping-cough, tetanus, strychnine poisoning, laryngismus stridulus, hyperemesis, asthma, sexual erethism with painful erections, etc.

6. Dyspeptic conditions with hyperesthesia of the solar plexus, gastric hyperesthesia and pylorospasm.

The bromides are **contraindicated in the presence of general depression** and, in particular, **when body nutrition is impaired and slowed.** Fatigue, exhaustion, low muscular tone, low blood-pressure, and the tendency to demineralization, betokening exhaustion of the nervous system, contraindicate the administration of bromides.

Bromism.—Prolonged and excessive use of potassium bromide leads to a form of intoxication known as bromism, characterized by the following symptoms: Malodorous breath, viscid saliva, indistinct speech, small pulse, lowered temperature of the extremities, and skin eruptions. In addition, there are noted pallor, mental hebetude, headache, amnesia, adynamia, loss of weight, indigestion and vomiting. The lower extremities become weak, all the limbs exhibit tremor, and the poisoned individual suffers from dizziness and shows disturbances of speech and handwriting, and delirium with hallucinations. A dry, paroxysmal cough sets in, and is followed by

broncho-pulmonary infections, the result of the weakened respiratory function. Bromism terminates in cachexia and coma. The patient under bromides should, therefore, be kept under careful observation, and the drug discontinued as soon as evidences of saturation appear.

MODES OF ADMINISTRATION.

BROMIDES OF POTASSIUM, SODIUM AND STRONTIUM.

1. SOLUTIONS:

℞ Potassii bromidi .... 20 grams (ʒv);
Aquæ destillatæ .... 300 c.c. (f℥x). —S.

One gram (15 grains) to the tablespoonful.

2. SYRUPS:

℞ Potassii bromidi .... 15 grams (℥ss);
Syrupi aurantii amari .... 300 c.c. (f℥x). —S.

One to three or four tablespoonfuls a day with meals, for *various conditions of nervous erethism.* One to three tablespoonfuls on retiring or in the night, for *insomnia due to mental excitement.*

3. TRIPLE BROMIDE SOLUTION:

℞ Potassii bromidi .... 40 grams (ʒx);
Sodii bromidi,
Ammonii bromidi,
Sodii benzoatis ....āā 12 grams (ʒiij);
Aquæ destillatæ ....q. s. ad 1 liter (Oij).

One gram (15 grains) of triple bromides to the tablespoonful.

Four to twelve grams (1 to 3 drams) a day (ascending by 1 gram each week, according to tolerance and effect) in *epilepsy.* (DE LA TOURETTE.)

4. DOUBLE BROMIDE SOLUTION:

℞ Potassii bromidi,
Sodii bromidi ....āā 1 gram (gr. xv);
Aquæ destillatæ .... 50 c.c. (fʒxiij);
Syrupi aurantii florum .... 37.5 c.c. (fʒx).—M.

About 0.05 gram (¾ grain) of each bromide per teaspoonful.

For use in children in teaspoonful doses, according to action and tolerance (in *nervous excitement, convulsive tendency, spasms,* etc.).

5. PILLS (a method practically limited to monobromated camphor).

℞ Camphoræ monobromatæ .... 0.15 gram (gr. iiss);
Extracti belladonnæ .... 0.01 gram (gr. 1/6);
Extracti valerianæ .... 0.1 gram (gr. iss).

Ft. pil. No. i. Da tal. No. xxx.

Sig.: Three to five pills a day, between meals, with a little infusion of orange leaves (2 per cent.). (For *spasmodic cough, palpitations,* and *cardiac neuroses.*)

6. Combinations with Bromides:

(*a*) ℞ Sodii arsenatis .... 0.15 gram (gr. ii¼);
Potassii bromidi .... 100 grams ((ʒxxv);
Aquæ destillatæ ....q. s. ad 1 liter (f℥xxxiij).

M. Sig.: Two to five tablespoonfuls a day, gradually ascending and then descending. (For *epileptic neurosis.*) (Grasset.)

(*b*) ℞ Sodii arsenatis .... 0.15 gram (gr. ii¼);
Potassii iodidi .... 30 grams (℥j);
Potassii bromidi .... 100 grams (ʒxxv);
Aquæ destillatæ ....q. s. ad 1 liter (f℥xxxiij).

M. Sig.: Two to four tablespoonfuls a day, gradually ascending and then descending. (*Jacksonian epilepsy.*) (Grasset.)

(*c*) ℞ Sodii arsenatis .... 0.1 gram (gr. iss);
Sodii iodidi,
Sodii bromidi ....āā 10 grams (ʒiiss);
Sodii chloridi .... 30 grams (℥j);
Aquæ destillatæ .... 300 c.c. (f℥x).

M. Sig.: One tablespoonful during the morning and the evening meals. (*Sluggish tuberculosis without fever or hemoptysis, but with glandular enlargements, nervous excitability, and restless nights.*)

Each tablespoonful of the foregoing prescription contains approximately 0.005 gram (1/12 grain) of sodium arsenate, 0.5 gram (7½ grains) each of sodium iodide and bromide, and 1.5 grams (22½ grains) of sodium chloride.

(*d*) ℞ Potassii bromidi .... 10 grams (ʒiiss);
Syrupi chloralis hydratis (5 per cent.),
Syrupi aurantii florum ....āā 75 c.c. (f℥iiss).

M. Sig.: One to two tablespoonfuls in the evening and at night (preferably in a cupful of some simple infusion). (For *insomnia due to excitement or incessant ideation.*)

(*e*) *Bromidia,* an American preparation which is hypnotic, sedative and calmative, contains in each teaspoonful:

Extracti hyoscyami,
Extracti cannabis ....āā 0.01 gram (gr. ⅙);
Chloralis hydratis,
Potassii bromidi ....āā 1 gram (gr. xv).

It is an effective combination, particularly serviceable in alcoholic delirium. An extemporaneous prescription of it can be made by selecting as a vehicle either a dilute orange-flower syrup or a syrup of bitter orange peel.

(*f*) ℞ Extracti hyoscyami,
Extracti cannabis ....āā 0.1 gram (gr. iss);
Chloralis hydratis,
Potassii bromidi ....āā 10 grams (ʒiiss);
Syrupi .... 100 c.c. (f℥iiiss);
Aquæ destillatæ .... 90 c.c. (f℥iij);
Fluidextracti aurantii amari (U.S.P. IX). 10 c.c. (fʒiiss).—M.

This preparation is less concentrated than the preceding one, one tablespoonful of it being equivalent to one teaspoonful of bromidia. The extemporaneous preparation of it is cloudy and of unsatisfactory appearance, with precipitation. A good preparation requires prolonged maceration and careful decantation.

(*g*) *Cachets for Migraine:*

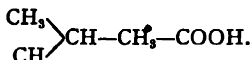
℞ Cocainæ hydrochloridi .... 0.01 gram (gr. 1/6);
Caffeinæ .... 0.02 gram (gr. 1/3);
Antipyrinæ,
Potassii bromidi ....āā 0.5 gram (gr. viiss);
Guaranæ pulveris .... 0.3 gram (gr. v).
Pone in cachet. No. i.
Sig.: To be taken at the first sign of an oncoming attack. (ALBERT ROBIN.)

* * *

VALERIAN. *Valeriana officinalis* (Valerianaceæ).—**A harmless substitute for the bromides.**—Valerian and its derivatives exert an appreciable depressant action on reflex excitability, but one which is much less pronounced than that of the bromides. It presents over the latter, however, the marked advantage of not exerting an unfavorable action on metabolism.

Good effects from valerian are obtainable in *nervous insomnia,* particularly that form of it which is accompanied by undue cardiac irritability, in *phobias,* in *headache,* in *hysteria* and its painful manifestations, in *epileptics* saturated with bromides, and in *some forms of neurasthenia.*

Valerian seems to owe its properties mainly to oil of valerian (an ill-defined mixture of pinene, camphene [$C_{10}H_{16}O$], borneol [$C_{10}H_{18}O$], and various esters, the most important of which appears to be bornyl valerate) and to valeric acid [$C_5H_{10}O_2$] or, more precisely, isovaleric acid:



MODES OF ADMINISTRATION.

1. PILLS:

(*a*) *Méglin's pills:*

℞ Extracti hyoscyami,
Extracti valerianæ,
Zinci oxidi ....āā 0.05 gram (gr. 3/4).
Ft. pil. No. i. Da tal. No. xxx.
Sig.: Three to six pills a day.

(*b*) The content of valerian in the above pills is rather low; there is advantage in prescribing somewhat more active pills, such as the following:

℞ Extracti hyoscyami,
Zinci oxidi .... āā 0.05 gram (gr. ¾);
Extracti valerianæ .... 0.1-0.15 gram (gr. iss-iiss).
Ft. pil. No. i. Da tal. No. xxx.
Sig.: Three to six pills a day.

(*c*) The antispasmodic action may, perhaps, be further augmented by combination with camphor and castoreum:

℞ Camphoræ .... 0.02 gram (gr. ⅓);
Castorei .... 0.06 gram (gr. j);
Extracti valerianæ .... 0.12 gram (gr. ij).
Ft. pil. No. i. Da tal. No. xx.
Sig.: One to six pills a day.

The indications for such preparations include: Nervousness, restlessness, insomnia, vascular spasm, cardiac intermittences, etc.

2. EXTRACTS:

Fluidextract of valerian, made from an equal weight of the fresh root. Of this two or three teaspoonfuls a day may be given in water sweetened with sugar or some simple infusion or elixir.

[*Tinctura valerianæ,* U. S. P., 20 per cent.; average dose, 4 c.c. (1 fluidram).

Tinctura valerianæ ammoniata, U. S. P., made by extracting valerian, 20, with aromatic spirit of ammonia, to make 100; average dose, 2 c.c. (30 minims).

Fluidextractum valerianæ, N. F.; average dose, 2 c.c. (30 minims).]

3. LIQUID COMBINATIONS:

℞ Fluidextracti valerianæ (N. F.) .... 6 c.c. (f℥iss);
Potassii bromidi .... 3 grams (gr. xlv);
Aquæ laurocerasi .... 10 c.c. (f℥iiss);
Syrupi ætheris (2 per cent.) .... 30 c.c. (f℥j);
Aquæ aurantii florum ....q. s. ad 150 c.c. (f℥v).
M. Sig.: One tablespoonful at hourly or three-hourly intervals, as long as required. (*In dyspeptics and in the cardiac neuroses, in the presence of palpitations or nervous irritability.*)

4. ENEMAS:

℞ Tincturæ opii .... gtt. iij;
Potassii bromidi .... 2 grams (gr. xxx);
Infusi valerianæ .... 150 c.c. (f℥v). —M.

5. VARIOUS UNOFFICIAL PREPARATIONS related to valerian have been placed on the market. Among them are:

Amyl valerate, the isoamyl ester of isovaleric acid, a clear liquid with an apple-like odor. Dose, 0.2 to 0.4 c.c. (3 to 6 minims) in capsules taken at short intervals.

Bornyval, or bornéol isovalerate, a colorless liquid having the odor and taste of valerian. Dose, 0.25 to 0.75 c.c. (4 to 12 minims) in gelatin capsules.

Valyl, or valeryl diethylamide, a colorless liquid with a peppermint-like odor. Dose, 0.12 to 0.4 c.c. (2 to 6 minims) in capsules.

Valerian, as is known, combines well with the hypnotics, particularly barbital (veronal). A preparation known as *valeronal,* exemplifying the last-mentioned combination, has been used.

C.—ANALGESICS—ANTIPYRETICS.

The analgesics and antipyretics are practically inseparable, and some of the terms used illustrate this close relationship, *e.g.,* antipyrin and analgesin, exalgin and antifebrin. The antipyretics, indeed, are in a varying degree also analgesic. Quinine, to be sure, is but an indifferent analgesic, but apart from malaria it is likewise an inconstant and uncertain antipyretic; sodium salicylate is a very unreliable antipyretic aside from acute rheumatism, but is likewise only slightly analgesic apart from this disorder; acetylsalicylic acid, though belonging to the same group, possesses alike much more pronounced antipyretic and analgesic properties.

The antipyretic action of these various compounds seems to depend mainly upon a depressant action exerted on the cerebral cortex, especially in relation to its sensory functions, so that their action is simultaneously sedative, analgesic (through depression of the sensory centers), antipyretic (through a regulating action on the heat centers), and in some degree hypnotic or narcotic.

* * *

Clinically, moreover, the question involved in this form of treatment is one of considerable importance. Much discussion has been and is still going on as to whether fever is a reactive phenomenon which is helpful or harmful, and consequently, whether it is a rational procedure to combat fever. Clinical experience seems to demonstrate that fever, at least when of moderate degree, is not at all prejudicial and that there is no very sound objective reason for combatting it under all circumstances. But as analgesics, and in a measure

as hypnotics, the antipyretics, when properly used, are generally of service, and at times of the greatest value, in that they antagonize two conditions undoubtedly very prejudicial to patients, *viz.,* pain and sleeplessness (see *Fever*).

Thus, the didactic groupings herein set up for convenience of description in respect of the different nerve-depressant agents are to be accepted only with due reservations.

In particular, the drug group known as the *antipyretics, analgesics* and *narcotics* constitute an irregular and with difficulty dissociated series beginning with *quinine* (an only slightly analgesic antipyretic), ending with *morphine* (an only very slightly antipyretic analgesic), and passing through *antipyrin.*

* * *

The **chemical constitution** of the antipyretic drugs is a subject that could easily lead to a prolonged discussion. Such a discussion would, however, certainly be out of place here. We shall limit ourselves to the following basic data.

I. One cannot fail to notice certain specific characteristics in the chemical make-up of the various antipyretics above alluded to:

1. All the antipyretics are cyclic compounds, with closed rings.

2. There is an obvious influence, diminishing in the order given, on the part of the methyl (CH_3), amine (NH_2) and phenol (C_6H_5) radicals.

II. For practical purposes the following classification of the *antipyretic-analgesic drugs* may be adopted:

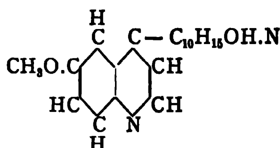
Non-nitrogenous: *Aromatic acids*
- Benzoic acid.
- Salicylic (and acetylsalicylic) acid.

Nitrogenous:
- *Anilids and paramidophenol*
  - Acetanilid (antifebrin).
  - Methylacetanilid (exalgin).
  - Acetphenetidin (phenacetin).
  - Lactophenin.
- *Pyrrol.*—Antipyrin and its derivatives (amidopyrin, salipyrin, trigemin).
- *Quinolin.*—Quinine and its derivatives.

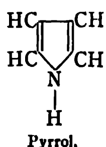
CHEMICAL CONSTITUTION OF THE ANTIPYRETICS.

Nitrogenous Compounds.

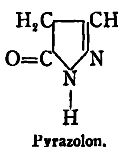
QUININE (Quinolin group).



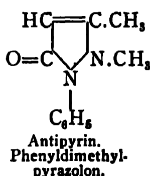
ANTIPYRIN, Analgesin (Pyrrol group).



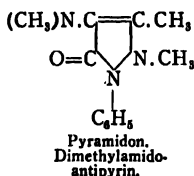
Pyrrol.



Pyrazolon.



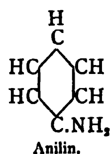
Antipyrin. Phenyldimethyl-pyrazolon.



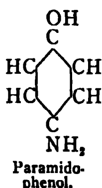
Pyramidon. Dimethylamido-antipyrin.

Trigemin. Dimethylamino-antipyrin-butylchloral-hydrate.

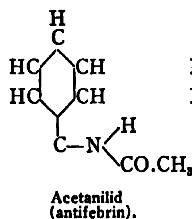
ACETPHENETIDIN, Phenacetin (Anilin and paramidophenol group).



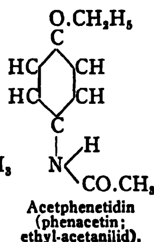
Anilin.



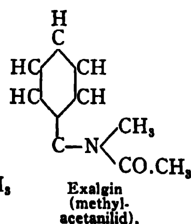
Paramido-phenol.



Acetanilid (antifebrin).



Acetphenetidin (phenacetin; ethyl-acetanilid).

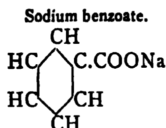


Exalgin (methyl-acetanilid).

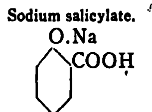
Non-Nitrogenous Compounds.

Salicylates.

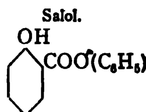
Sodium benzoate.



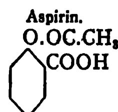
Sodium salicylate.



Salol.



Aspirin.



When and Why Antipyrin or Amidopyrin should be Administered.

The clinical indications for **antipyrin** show a close relationship to its pharmacodynamic properties.

1. As an *analgesic* of the first rank, it is indicated in most *painful disorders of the neuralgic type,* in which it constitutes a remedy of choice.

2. Its *depressant action on the reflex motor functions* makes of it an *antispasmodic,* especially effective in children.

3. Its *trophic* action, restricting metabolic processes, including glycogenesis in particular, makes it an *antidiabetic* agent.

4. Its *local vasoconstrictor* action, in conjunction with its analgesic and antiseptic properties, renders it a valuable *local hemostatic.*

Lastly, its *antipyretic* action, with due reservations in deference to numerous and formal contraindications, is nonetheless available in some cases of fever, especially in children.

The physiologic action and indications of **amidopyrin (pyramidon)** are in all respects identical (with the exception, perhaps, of the action on metabolism) with those of antipyrin.

The foregoing statement is subject, however, to the existence of two contraindications:

1. Since it increases oxidation, *it is contraindicated in diabetics,* whereas antipyrin is not (A. Robin).

2. As it induces diaphoresis which is sometimes excessively pronounced, it is *contraindicated* even more definitely than antipyrin *in debilitated, cachectic, and in particular, tuberculous patients.*

Untoward Effects of Antipyrin.—Evidences of intolerance and toxic manifestations of varying severity are frequently observed following the administration of antipyrin. The possibility of dangerous degrees of idiosyncrasy has to be borne in mind. Small doses, such as 0.3 to 0.5 gram (5 to 7½ grains), are sufficient in some subjects to produce alarming effects.

The commonest untoward effects are those manifested on the skin and mucous membranes: Erythematous or bullous eruptions, with or without accompanying edema of the skin, mucous membranes, glottis or genitals, and sometimes with fever and a varying degree of leukocytic reaction. In grave cases there have been observed pemphigus, extensive ulcerative and membranous stomatitis, decubital ulcers, etc.

In the alimentary tract, intolerance is frequent. It can usually be obviated by administering the antipyrin in alkaline solution.

As regards the nervous system, profuse sweats, hypothermia, and a tendency to collapse or even coma have been observed, especially in tuberculous and cachectic subjects, in whom the drug should be avoided.

In relation to the circulatory system, cyanosis, low blood-pressure, and intermittences have been noted with some frequency. It will be wise to abstain from it in heart cases, especially when low pressure coexists.

Albuminuria has been observed especially after prolonged administration, even of small doses.

Incompatibilities.—Antipyrin is precipitated from its solutions by:

1. Tannic acid and tannin-containing preparations.
2. Tincture of iodine.
3. The chlorides of mercury.

The following substances decompose antipyrin when triturated with it in dry form:

1. Calomel, which forms a toxic compound with antipyrin.
2. Chloral hydrate, which forms an oily liquid.

Finally:

1. The solubility of the salts of quinine and of caffeine is increased by the addition of antipyrin (a point to be remembered in relation to formulas for hypodermic injection).

2. Sodium salicylate powdered with antipyrin forms an oily mixture (this combination should be prescribed only in liquid preparations).

Tests for Antipyrin in the Urine.—To 6 c.c. of the urine to be tested, previously acidulated, add 5 drops of Lugol's solution. If the urine contains antipyrin, even only in traces, a dull red precipitate is produced.

For this searching, but too exceedingly sensitive, procedure one may, for practical purposes, substitute the following, which, however, is much less characteristic: Decolorize the urine with lead subacetate and add 1 or 2 drops of ferric chloride solution, which gives a purplish red reaction with antipyrin.

MODES OF ADMINISTRATION OF THE ANTIPYRETICS.

Antipyrin.—The method of choice should be its use in a liquid preparation, as antipyrin is freely soluble, has no unpleasant taste, and exerts (when suitably guarded with sodium bicarbonate) no harmful action on the stomach.

The usual method followed by the laity as well as the medical practitioner for reasons of convenience and economy is that of the tablet or simple powder. Cachets may also be used.

1. CACHET:

℞ Antipyrinæ,
Sodii bicarbonatis .... āā 0.4 gram (gr. vj).
Ft. cachet No. i.
Sig.: To be taken with a cupful of some warm beverage.

2. SOLUTION:

℞ Antipyrinæ .... 2 grams (ʒss);
Sodii bicarbonatis .... 1 gram (gr. xv);
Aquæ destillatæ .... 60 c.c. (f℥ij).—S.

3. OTHER LIQUID PREPARATIONS:

℞ Antipyrinæ .... 2 grams (ʒss);
Elixiris aromatici,
Syrupi acaciæ .... āā 30 c.c. (f℥j);
Aquæ destillatæ .... 20 c.c. (fʒv).
M. Sig.: One tablespoonful at a dose.

℞ Antipyrinæ .... 2 grams (ʒss);
Sodii bicarbonatis .... 1 gram (gr. xv);
Spiritus vini vitis .... 10 c.c. (fʒiiss);
Aquæ destillatæ,
Syrupi aurantii .... āā 30 c.c. (f℥j).
M. Sig.: One tablespoonful at a dose.

4. ENEMA:

℞ Antipyrinæ .... 1 gram (gr. xv);
Tincturæ opii .... gtt. j;
Aquæ bulliatæ .... 60 c.c. (f℥ij).
M. Sig.: To be warmed before use.

5. EXTERNAL USE.—Antipyrin may be applied externally in the form of a more or less concentrated solution in *local hemorrhages,* accessible wounds of mucous membranes, *wounds of the lips,* and *epistaxis.*

A 20 to 50 per cent. solution is a useful substitute for adrenalin or hydrogen peroxide; in epistaxis, in particular, I have always had satisfactory results from its use.

6. OINTMENT.—Antipyrin incorporated in an ointment is also available as a local analgesic and hemostatic, though little used in this way by the profession at large. Thus, in *excoriations* and *anal fissures* one might prescribe:

℞ Quininæ hydrochloridi .... 0.05 gram (gr. ¾);
Antipyrinæ,
Zinci oxidi .... āā 2 grams (ʒss);
Adipis lanæ hydrosi,
Petrolati .... āā 10 grams (ʒiiss).
M. Sig.: For external use.

Amidopyrin.

1. CACHET:

(a) ℞ Amidopyrinæ .... 0.3 gram (gr. v).
Pone in cachet. No. i. Da tal. No. x.
Sig.: One or two cachets in 24 hours.

(b) ℞ Quininæ hydrobromidi,
Amidopyrinæ ....āā 0.15 gram (gr. iiss).
Pone in cachet. No. i. Da tal. No. xx.
Sig.: Two to four cachets in 24 hours.

2. LIQUID PREPARATION:

℞ Amidopyrinæ .... 1 gram (gr. xv);
Syrupi aurantii .... 40 c.c. (f℥x);
Aquæ destillatæ .... 60 c.c. (f℥ij).
M. Sig.: Two to three tablespoonfuls in 24 hours.

Combinations with Antipyrin and Amidopyrin.

(a) CORRECTIVE COMBINATIONS:

Sodium bicarbonate may be given with antipyrin to counteract its undesirable action on the gastric mucosa and improve tolerance of it. Thus, 0.5 gram (7½ grains) of antipyrin may be taken in conjunction with one-fourth glassful of Vichy water. Or:

℞ Antipyrinæ,
Sodii bicarbonatis ....āā 0.5 gram (gr. viiss).
Ft. cachet. No. i.
Sig.: To be taken with some warm infusion.

If, as seems preferable, the drug is to be given in a solution, one may prescribe:

℞ Antipyrinæ .... 5 grams (gr. lxxv);
Aquæ Vichyanæ .... 80 c.c. (f℥iiss). —S.

One tablespoonful of the above solution will contain 1 gram (15 grains) of antipyrin.

A plan which is more pleasant for the patient is to prescribe an effervescent powder:

Powder No. 1:

Antipyrinæ,
Sodii bicarbonatis ....āā 1 gram (gr. xv).

Powder No. 2:

Acidi citrici .... 0.6 gram (gr. x).
Sig.: The two powders to be mixed in a glassful of sweetened water just before use.

This citric effervescent preparation is especially suitable in migraine and in seasickness.

(*b*) SYNERGISTIC COMBINATIONS.—In general, experience shows that there is marked advantage in combining analgesics belonging to different chemical groups. There is more than a mere summation of effect from such combinations.

The following formula represents such a combination:

℞ Caffeinæ	0.05	gram	(gr. ¾);
Exalgin	0.1	gram	(gr. iss);
Acetphenetidini	0.15	gram	(gr. ii¼);
Amidopyrinæ	0.2	gram	(gr. iij).

Pone in cachet. No. i.

In debilitated patients it may be advisable to combine with antipyrin, and especially with amidopyrin, some corrective *heart-stimulant* calculated to counteract the depressant effects, as in the following prescriptions:

℞ Strychninæ sulphatis	0.01	gram	(gr. ⅙);
Amidopyrinæ	1	gram	(gr. xv);
Syrupi aurantii	40	c.c.	(fʒx);
Aquæ destillatæ	60	c.c.	(f℥ij).

M. Sig.: Two to three tablespoonfuls in 24 hours.

The combination of antipyrin with *sodium salicylate* is very effectual in prolonged acute rheumatic conditions. The quasi-specific action of the sodium salicylate is sometimes reinforced by it. Mixed powders of salicylate and antipyrin turn, however, into a pasty mass which precludes their administration in cachets or powder form; such a mixture would, moreover, have little to recommend it by reason of the irritant action of the combined drugs on the stomach; finally, it would be advisable to add some sodium bicarbonate. Accordingly, one might prescribe:

℞ Antipyrinæ	5	grams	(gr. lxxv);
Sodii bicarbonatis	6	grams	(ʒiss);
Sodii salicylatis	10	grams	(ʒiiss);
Aquæ destillatæ	10	c.c.	(fʒiiss);
Spiritus jamaicensis	30	c.c.	(f℥j);
Syrupi aurantii	150	c.c.	(f℥v). —M.

One tablespoonful of the above preparation contains about 0.8 gram (12 grains) of sodium salicylate and 0.4 gram (6 grains) of antipyrin.

The combination of *quinine* and antipyrin is advantageous in more than one respect:

1. It markedly increases the solubility of the quinine salts and consequently makes their absorption more certain.

2. It combines in a useful manner the analgesic action of antipyrin with the antipyretic action of quinine, which it shares and reinforces.

3. It reduces the reflex irritability of the nervous system, sometimes so pronounced in febrile cases.

The best forms of administration in this connection, in view of the strongly bitter taste of quinine, are in cachets and in an enema or suppository:

℞ Antipyrinæ .... 0.6 gram (gr. ix);
Quininæ dihydrochloridi .... 0.4 gram (gr. vj).
Ft. cachet. No. i .
Sig.: To be taken in some hot infusion.

℞ Quininæ hydrobromidi .... 0.4 gram (gr. vj);
Antipyrinæ .... 1 gram (gr. xv);
Aquæ tiliæ .... 150 c.c. (f℥v).
M. Sig.: For a lukewarm enema.

PYRETHANE, a methyl-polyamino derivative of pyrazol carbamate of ethyl, is a powerful antineuralgic and antipyretic, featured particularly by its free solubility which permits of its being readily administered hypodermically or in solution.

It may be prescribed either:

In drops, diluted in some fluid (preferably some sodium bicarbonate water), in an average dosage of 20 to 50 drops, to be repeated at twenty minute intervals until the required sedative effect has been obtained (300 drops a day), or,

By hypodermic injection (ampules of 2 and 5 c.c.), one or two a day, according to indications, preferably intramuscularly.

ACONITE. *Aconitum napellus* (Ranunculaceæ).—A separate place should be reserved for the preparations of aconite.

The action of this drug, according to the investigations of Laborde and Duquesnel, at first confined to the bulbospinal portion of the central nervous system, then extends to the sympathetic system and finally to the entire organism.

In therapeutic doses, it causes a primary stimulation of rather brief duration, manifested in acceleration of the pulse, with a slight rise of blood-pressure, acceleration and increased amplitude of the respiratory movements, a slight rise in temperature, and an evanescent increase of general sensibility, followed by a stage of depression with resulting reduced cardiac and respiratory rates, with slight reduction of blood-pressure, lowering of temperature, a secondary diminution of general and special sensation, and an analgesic action exerted selectively in the trifacial distribution. This action is accompanied by an almost general increase of secretion, including the sweat, bile and urine. Atropine is antagonistic to aconitine in respect of the above-mentioned actions.

In toxic doses, aconite produces death through depression and arrest of the heart and respiration. The danger of actual poisoning is heralded by nausea, vomiting, small pulse, coolness of the extremities, dilatation of the pupils, and profuse sweating. Atropine is, in a measure, an antidote to these effects. The earliest signs of intolerance, with which one should be thoroughly familiar, are dryness of the throat, numbness and tingling in the extremities, an uncomfortable sensation of swelling of the tongue and lips, and an unpleasant feeling of tension in the stomach.

Clinically, although its exact mode of action is very imperfectly known, aconite certainly exerts a valuable action on the trifacial nerve (*rebellious neuralgia*), on the bulbospinal portion of the central nervous system (*refractory cough*), on the sympathetic (*many instances of tachycardia*), and on the thermogenic centers (*febrile states of bronchopulmonary origin*).

PREPARATIONS AND DOSAGE.

Of the several official preparations of aconite, mention will be made of only two, which appear sufficient for all clinical uses, *viz.*, the *tincture* and *aconitine.* The former [*Tincturæ aconiti,* U. S. P.; average dose 0.6 c.c. (10 minims)] is standardized biologically, a definite range of minimum lethal dosage per gram of guinea-pig being required. One gram [approximately 20 minims] of this tincture contains about 0.0005 gram (1/130 grain) of aconitine, and yields 50 standard drops.

One can easily prescribe a 1 : 2000 glycerin-alcohol solution of aconitine, *i.e.*, a solution containing 0.0005 gram of the alkaloid to the gram and yielding 50 drops to the gram, like the tincture just referred to. Thus:

℞ Aconitinæ (crystalline)	0.005	gram	(gr. 1/13);
Aquæ destillatæ	1.5	c.c.	(♏xxiv);
Glycerini	3.5	c.c.	(♏lv);
Alcoholis q. s. ad	10	c.c.	(f℥iiss). —M.

Granting—as one may and should do—that from the pharmacologic and clinical standpoints *total alkaloids = crystalline aconitine,* the two preparations are practically equivalent from the pharmacologic and toxic standpoints, with this sole difference, *viz.*, that crystalline aconitine is, by definition, pure aconitine, while the active principles of the tincture are the total alkaloids (crystalline aconitine, amorphous aconitine, napelline).

Of the aconitine solution above formulated:

5 drops	= 0.00005	gram	(1/1300 grain).
10 "	= 0.0001	"	(1/650 grain).
20 "	= 0.0002	"	(1/325 grain).
25 "	= 0.00025	"	(1/260 grain).
50 "	= 0.0005	"	(1/130 grain).

ANTIPYRETICS AND ANALGESICS.

COMPOUNDS.	PREPARATIONS.	MAXIMUM DOSES.		PHARMACOLOGIC ACTION.	CLINICAL INDICATIONS.	CONTRA-INDICATIONS.	REMARKS.
		Single.	*Daily.*				
			Nitrogenous Compounds.				
ANILIDS AND PARAMIDO-PHENOL.							
Acetanilid.	Powder. Tablets. Cachets.	0.3 gram	1.5 grams	Analgesic. Antipyretic. Hypotensor.	*Neuralgic states. Insomnia with pain. Fever.*	*Depression, markedly low blood-pressure, tendency to fainting spells, syncope or cyanosis.*	Instances of pronounced *idiosyncrasy*, while exceptional, must be reckoned with. The commonest untoward symptoms are those relating to the *skin and mucous membranes:* Erythematous or bullous eruptions, pemphigus, and ulcerative or ulceromembranous stomatitis. As regards the *digestive tract*, cramps, burning sensations and vomiting may be observed. As regards the *nervous system*, there is depression of varying degree, with sweating and lowered blood-pressure.
Exalgin (methyl-acetanilid).	Powder. Tablets. Cachets.	0.2 gram	0.8 gram	Do.	*Do.*	—	
Acetphenetidin (phenacetin).	Powder. Tablets. Cachets.	1 gram	3 grams	Do.	*Do.*	—	
PYRROL GROUP.							
Antipyrin.	Powder. Tablets. Cachets. Solution or mixture.	1 gram	3 grams	Analgesic. Antipyretic. Antirheumatic. Alterative.	*Neuralgic states. Insomnia with pain. Fever.*	*Do. Renal insufficiency.*	
Amidopyrin.	Powder. Tablets. Cachets.	0.5 gram	1.5 grams	Do., but accelerates metabolism.	*Muscular pains. Rheumatic pains. Diabetes.*	—	
Salipyrin.	Cachets. Alcoholic liquid preparation.	1 gram	5 grams	Do.	—	—	

QUINOLIN GROUP. **Quinine sulphate.**	Pills. Cachets. Suppositories (in children).	1 gram	3 grams	Antimalarial. Antipyretic. Reducer of oxidation processes.	*Malaria.* *Typhoid fever.* *Various fevers.* *Septicemia.* *Sympathetic neuroses.*	*Internal ear disease.*	Quinine is a basic substance having 2 bonds of affinity for acids. It yields, therefore, 2 series of salts, *viz.*, the neutral salts, in which but one of these bonds is satisfied by acid, and the basic salts, in which both bonds are satisfied. The *neutral* salts, much the more soluble, are preferable for hypodermic use and should be preferred under all circumstances. The *basic* salts, much less soluble, contain, however, a somewhat larger percentage of quinine.
Quinine dihydrochloride.	Pills. Cachets. Suppositories. Subcutaneous or intramuscular injections (10 per cent. solution with addition of antipyrin).	0.7 gram	2 grams	Tonic. Stomachic.	—	—	
Quinine hydrobromide, hydrochloride, or bisulphate.	Subcutaneous or intramuscular injections (10 per cent. solution).	0.7 gram	2 grams	—	—	—	
Non-Nitrogenous Compounds.							
AROMATIC ACIDS. **Sodium salicylate.**	Powder. Tablets. Cachets. Solutions.	2 grams	10 grams	Antirheumatic. Antipyretic. Cholagogue.	*Acute rheumatism.* *Rheumatic sore throat.* *Hepatic disorders.*	*Internal ear disease.*	—
Acetylsalicylic acid (Aspirin).	Powder. Tablets. Cachets. Solutions.	1 gram	5 grams	Promotes solution and elimination of toxic compounds. Antipyretic. Analgesic. Antiseptic.	*Joint infections.*	*Depression. Low blood-pressure. Tendency to collapse.*	—

The maximum single dose of crystalline aconitine, as specified in the French Codex, is 0.0002 gram (1/325 grain), or 20 drops of the above solution; the maximum in 24 hours, 0.0005 gram (1/130 grain), or 50 drops.

In the case of the tincture of aconite the maximum single dose is given as 0.5 gram (about 10 minims), or 25 drops, and the maximum for 24 hours, as 1.5 grams (about 30 minims), or 75 drops.

An unofficial aconitine salt which lends itself to methodical, ascending, and accurate dosage is *aconitine nitrate.* The maximum doses are the same as those given above for crystalline aconitine.

Clinical observation has shown that after having very cautiously tested the susceptibility, one can and should, on occasion, raise the dosage. Trifacial neuralgia, for instance, is a sufficiently agonizing disorder to justify the practitioner in making a definite attempt to relieve it and in being, if necessary, somewhat bold in his treatment.

[Prevailing opinion in the United States is against the internal use of aconitine, in view of the marked discrepancies in the activity of the various commercial aconitines. If it is used in this manner, caution in dosage is imperative. In the case of the tincture, somewhat greater latitude seems permissible, clinical tests showing that from 1.5 to 3 c.c. (20 to 45 minims) may be required to induce the more pronounced physiologic effects.—TR.].

D.—SIMPLE HYPNOTICS.

Empirical observation and systematic experimentation have revealed the presence, in the substances possessing hypnotic properties, of certain characteristic groups of atoms which permit of their being classified in a manner both logical and comprehensive, and hence also practical:

Halogen hypnotics, characterized mainly by the presence of *chlorine* or *bromine* radicals.

Chloral (trichloracetaldehyde), $CCl_3.CHO$; the substance used in medicine, however, is *hydrated chloral,* $CCl_3.CHO.H_2O$.

As a subsidiary remedy, one may assimilate to this group:

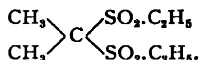
Bromoform, $CHBr_3$, the similarity of which to *chloroform,* $CHCl_3$, is at once apparent.

Ethyl hypnotics, characterized mainly by the presence of the C_2H_5 radical (ethyl), which is present in most of the hypnotics (sulphone and urea derivatives) to be mentioned below.

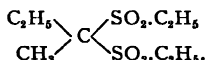
Ethyl alcohol, C_2H_5OH, is likewise hypnotic, but only in doses so large and so close to the toxic amounts that it can be employed for this purpose only under exceptional circumstances.

Sulphone hypnotics, characterized by the presence of the $SO_2.C_2H_5$ group. The two most commonly used members of this group are:

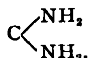
Sulphonal (sulphonmethanum):



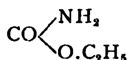
Trional (sulphonethylmethanum):



Urea hypnotics, characterized by the presence of the ureic radical:

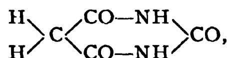


Urethane (ethyl carbamate; oxyethyl urea):



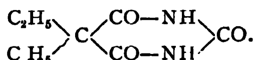
has not been the source of any extensively used derivatives.

Barbituric acid (malonyl urea):

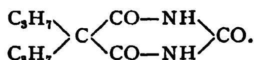


on the other hand, has supplied, through the addition of alcohol radicals, countless derivatives among which are many hypnotics now in widespread use:

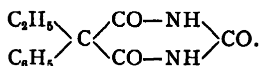
Diethylbarbituric acid (barbital; veronal):



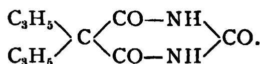
Dipropylbarbituric acid (proponal):



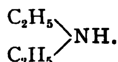
Phenylethylbarbituric acid (phenobarbital; luminal; gardenal):



Diallylbarbituric acid (dial):



Among the sodium and diethylamine derivatives of these different compounds, special mention should be made of the *diethyl-diallylbarbiturate of diethylamine,* or *somnifen,* a soluble compound of diethyl and diallyl barbituric acids with diethylamine:



Bromo-ureic hypnotics.—*Carbromal* (brom-diethylacetylurea).

Isobromyl (α-monobrom-isovalerylurea).

Alkaloidal hypnotics, represented mainly by *opium and its derivatives,* and more particularly, for practical purposes, by:

(*a*) *Morphine* and its derivatives:

Diethylmorphine hydrochloride (dionin).

Diacetylmorphine (heroin).

(*b*) The *total, soluble and standardized extracts of opium (pantopon, omnopon)* (see *Opium*).

(*c*) *Didial* (diallyl-malonylurate of ethylmorphine), which constitutes essentially a synthetic combination of urea with an alkaloid.

* * *

From the standpoint of administration, certain additional remarks are in order.

There is to be noted the **insolubility** of the majority of the hypnotics, including, in particular, the *sulphones* and the *urea derivatives,* which are relatively very soluble in oils and but sparingly soluble in water, so that the partition coefficient $\frac{\textit{solubility in oils}}{\textit{solubility in water}}$ of most of the hypnotics is very high, in consequence of which their affinity for organic substances, particularly the lipoids of the brain, is likewise very great. This fact, as is well known, forms the basis of the theory of Meyer and Overton. *This*

theory seems to be correct insofar as the sulphones and the urea compounds are concerned.

It is not applicable, however, in the case of chloral hydrate or the alkaloidal hypnotics (morphine). It brings in a practical corollary of some significance, *viz.*, the *practical impossibility of administering the hypnotics by the hypodermic route, except in the case of morphine* and its derivatives, the sulphones and urea derivatives being almost insoluble in water, while chloral hydrate is too irritating.

This pharmacologic desideratum is of extreme importance, for many are the cases in which such administration would be of great service (dementias, digestive disorders, gastric tumors). For the present the only hypnotics suited for administration by injection are:

1. The *soluble derivatives of opium* (morphine group, pantopon, etc.).

2. *Chloralose,* injected intravenously; but this drug, concerning which but little is as yet known, has not been used much so far, and only exceptionally as an anesthetic.

3. A derivative of barbital (veronal) obtained by the substitution of a phenyl group for an ethyl group (*luminal* or phenyl-ethyl-malonyl urea) dissolves rather readily in dilute alkaline solutions, so that it can be administered by the hypodermic route in doses of 0.1 to 0.3 gram (1½ to 5 grains). This is an effective, but violently acting hypnotic.

4. The *sodium* and *diethylamine derivatives* of most of the barbituric acid compounds are relatively soluble. The *diethyl-diallylbarbiturate of diethylamine* (*somnifen*) is soluble to the extent of 30 per cent. and can, therefore, be given by the hypodermic route (either intravenously or intramuscularly, to obviate all local pain or necrosis).

[5. *Scopolamine* (*hyoscine*) *hydrobromide* also belongs in this category.]

* * *

A rather useful plan is to classify the hypnotics according to their power into *weak, intermediate* and *strong.*

Weak hypnotics (sedative rather than hypnotic): Urethane, the bromides, and valerian.

Intermediate hypnotics (true hypnotics): Chloral hydrate, dial, carbromal, morphine, sulphonal, trional.

Strong hypnotics: Barbital, didial, somnifen.

Obviously, it is necessary to take into account the dose administered and the individual reaction to the drug.

One may be led to inquire, in view of this variety of hypnotic groups, whether it is worth while to *combine* them. In a general way, it would seem that such combination is not to be recommended and that the combination, *e.g.*, of the sulphones with the urea derivatives is more disadvantageous in exposing the patient to untoward results than it is advantageous in other respects.

An exception should be made, however, in favor of the combinations of chloral with morphine and, perhaps, of barbital with morphine. The first of these combinations is a classical one. The second is sometimes valuable in certain refractory insomnias.

Combination of chloral with bromides, and of barbital with various derivatives of valerian, is likewise very serviceable.

Finally, attention may be called to the combination of various hypnotic atom-groups in the molecule of the more recent hypnotics. Thus, carbromal combines two ethyl (C_2H_5) groups and an atom of bromine with an acetyl-urea group.

* * *

The majority of the hypnotics lower the blood-pressure, sometimes to a very appreciable extent. This is the case, in particular, with *chloral hydrate,* which is an active and frequently useful vasodilator. The action of *barbital* in this direction is still under discussion; until more definite information is obtained, it will be well to abstain from it in arteriosclerotic subjects with high blood-pressure. *Carbromal,* on the other hand, seems to exert a slight vasodilator action which extends, perhaps, to the coronary vessels, and would accordingly appear to be the hypnotic of choice in cardiopathic and neuro-cardiopathic (anginal) cases.

* * *

As for the *collateral and consecutive effects,* toxic effects, persisting depression of the nervous system, and cardiorenal manifestations, the likelihood of harm would appear to be as follows, in the order of decreasing risk:

Sulphones (trional, sulphonal), luminal, barbital, morphine, carbromal, chloral hydrate.

The sulphones are really little to be recommended on account of their prejudicial action on the blood and kidneys (hematoporphyrinuria), the slowness of their elimination, and in consequence, the prolonged torpor which results from their use. Indeed, they have been the cause of most serious cases of poisoning.

Frequent changing from one hypnotic to another obviates the acquisition of tolerance and reduces the risk of intoxication.

Insomnia being, with *pain,* one of the most common, persistent and intolerable symptoms, *hypnotic habit formation* is probably that which the practitioner has most often occasion to observe and to treat, whether the drug concerned be chloral hydrate, morphine, or barbital; in the large cities there are chloral, morphine and barbital habitués without number.

FORMULAS.

CHLORAL HYDRATE.

1. Chloral syrup is recognized in the French Codex. Of this (5 per cent.) syrup, 20 grams (1 tablespoonful) contain 1 gram (15 grains) of chloral hydrate. One to four tablespoonfuls at night.

2. ℞ Chloralis hydratis .... 1-3 grams (gr. xv-xlv);
Vitelli ovi .... No. j;
Aquæ .... 60 c.c. (f℥ii).

M. Sig.: For a lukewarm enema, to be retained.

BROMOFORM:

℞ Bromoformi .... 5 grams (♏xxix);
Glycerini .... 15 grams (f℥iij);
Alcoholis .... 30 grams (f℥x).—M.

This preparation is of the same specific gravity as water, and contains 10 per cent. by weight of bromoform. One cubic centimeter (16 minims) of it yields 60 drops and contains 0.1 gram (approximately 3/5 minim) of bromoform. [In this prescription it was deemed inadvisable to depart from the usual French system of expressing the amounts even of fluid ingredients in grams. The apparent discrepancy between the quantities of bromoform as expressed in grams and in minims is due to the fact that the specific gravity of bromoform is 2.8.—TR.]

The dose is 1 to 3 tablespoonfuls (at most) in the twenty-four hours, administered in some syrupy fluid.

BARBITAL (VERONAL).—Dose, 0.3 to 0.5 gram (5 to 7½ grains) in tablets, cachets, or powder, with some hot infusion.

DIAL.—Tablets of 0.1 gram (1½ grains).—One or, at most, two tablets.

CARBROMAL.—Tablets of 0.35 gram (5 grains).—Two or three tablets in some hot liquid, for hypnotic purposes.

SOMNIFEN.—1. Twenty to thirty, up to sixty drops in a quarter-glassful of water one-half hour before retiring.

2. One or two ampules intramuscularly or subcutaneously.

HYPNOTICS.

	PREPARATIONS.	MAXIMUM DOSES. Single.	MAXIMUM DOSES. Daily.	PHARMACOLOGIC ACTION.	CLINICAL INDICATIONS.	CONTRA-INDICATIONS.	REMARKS.
ALCOHOL.							
Ethyl alcohol. C_2H_5OH	Alcoholic liquors. Infusions with addition of alcohol.	—	—	Hypnotic. Vasodilator. Diuretic. Diaphoretic.	*Infections. Pneumonia.*	—	Formerly employed with opium (opium wines) for hypnotic and anesthetic purposes.
HALOGENS.							
Chloral hydrate. $CCl_3.CHO.H_2O$	Solutions. Enemas.	4 grams	8 grams	Hypnotic. Vasodilator and hypotensor. Anti-asthmatic. Antispasmodic. Diuretic.	*Nervous insomnia (alcoholic, maniacal, delirious). Convulsions (infantile, puerperal, tetanic, strychnic). High blood-pressure.*	*Low blood-pressure. Cardiac arhythmias. Cyanosis.*	With morphine, this is the oldest, most reliable, and least harmful of the hypnotics. Combinations of it with morphine or with bromides may be advantageous.
Bromoform. $CHBr_3$	Oily electuary. Syrup. Elixir. Saturated watery solution.	0.5 c.c.	1.5 c.c.	Cough sedative. Hypnotic. Antispasmodic.	*Whooping-cough and similar coughs. Gastralgia.*	*Cyanosis. Arhythmia.*	The patient should be carefully watched, as the toxic action is close to the therapeutic action (cyanosis, arhythmia, erythema).
SULPHONES.							
Sulphonal (sulphonmethanum). $(CH_3)_2{:}C{:}(C_2H_5SO_2)_2$	Powder. Cachets. Enemas. Suppositories.	2 grams	4 grams	Hypnotic.	*Nervous insomnia.*	*Cyanosis. Heart disturbances.*	The sulphones are hardly to be recommended in view of their prejudicial effects on the blood

Trional (sulphonethyl-methanum). $C_2H_5.CH_3: C:-(C_2H_5SO_2)_2$	Powder. Cachets.	1 gram	2 grams	Hypnotic.	*Nervous insomnia.*	—	and kidneys (hematoporphyrinuria) and the slowness of their elimination.
UREA COMPOUNDS.							
Urethane (ethyl carbamate). $CO<^{O.C_2H_5}_{NH_2}$	Solution. Syrup.	3 grams	6 grams	Unreliable hypnotic.	*Nervous insomnia. Alcoholic delirium. In children (0.1 gram per year of age).*	*Do.*	Its use is hardly to be attempted except in children.
Barbital (veronal) Diethyl-malonyl-urea.	Tablets. Powder. Cachets.	0.6 gram	1.2 grams	Powerful hypnotic.	*Nervous insomnia.*	*Weakness. Vertigo. Venous stasis.*	—
Soluble barbital (sodium-barbital).	Tablets. Cachets. Solution.	0.6 gram	1.2 grams	Do.	*Do.*	*Cardiac weakness.*	—
Luminal (phenobarbital) Phenyl-ethyl-malonyl-urea.	Tablets.	0.2 gram	0.3 gram	Do.	*Refractory insomnia. Nervous excitement. Epilepsy.*	—	—
Dial Di-allyl-malonyl-urea.	Tablets.	0.2 gram	0.3 gram	Hypnotic. Nervous sedative.	*Heart cases. Emotive cases. Neurasthenics.*		Rapidly absorbed and eliminated.
Somnifen. Diethylamine diethyl-diallyl-barbiturate.	Drops. Ampules for injections.	30 drops 3ampules	60 drops 6ampules	Hypnotic. Sedative. Anesthetic.	*Insomnia. Nervous excitement. Convulsions.*		May be given intravenously and intramuscularly.

HYPNOTICS (*continued*).

	PREPARATIONS.	MAXIMUM DOSES. Single.	MAXIMUM DOSES. Daily.	PHARMACOLOGIC ACTION.	CLINICAL INDICATIONS.	CONTRA-INDICATIONS.	REMARKS.
BROMO-UREIC COMPOUNDS.							
Bromural Brom-isovaleryl urea.	Tablets. Cachets.	0.6 gram	1 gram	Strong hypnotic. Nervous sedative.	*Nervous insomnia. Neuroses with increased irritability (overwork, hysteria, cardiac neuroses).*	*Depression. Poor nutrition.*	
Carbromal. Brom-diethyl-acetyl urea.	Tablets of 0.35 gram.	0.7 gram	1 gram	Hypnotic. Nervous sedative.	*Heart cases. Emotive cases. Neurasthenics. Psychoneurotics.*	—	Little tendency to habit formation. Very well borne by heart cases.
ALKALOIDAL COMPOUNDS.							
Opium and its Derivatives.	See separate table.						
Didial. Diallyl-malonylurate of ethylmorphine.	Tablets of 0.1 gram.	0.2 gram	0.6 gram	Hypnotic. Nervous sedative.	*Anxiety neurosis. Agrypnic cases. Periodic depressive psychoneuroses.*		

DIDIAL.—Tablets of 0.1 gram (1½ grains), including 0.02 gram (⅓ grain) of ethylmorphine.—To be used with considerable caution and reserved for cases that are really very refractory

PHENOBARBITAL (LUMINAL).—Tablets of 0.1 or 0.05 gram (1½ or ¾ grains) for adults and of 0.01 gram (⅙ grain) for children. One to 4 tablets in 24 hours in adults.

Drug Combinations.

CHLORAL HYDRATE:

(*a*) ℞ Syrupi chloralis hydratis (5 per cent.),
Syrupi morphinæ (0.05 per cent.) ....āā 30 c.c. (f℥j).
M. Sig.: One to four tablespoonfuls (in *insomnia with pain*).

(*b*) ℞ Syrupi chloralis hydratis (5 per cent.),
Syrupi morphinæ (0.05 per cent.) ....āā 23 c.c. (fʒvj);
Aquæ aurantii florum .... 40 c.c. (fʒx).
M. Sig.: One tablespoonful every three hours.

(*c*) ℞ Sodii bromidi .... 10 grams (ʒiiss);
Syrupi chloralis hydratis (5 per cent.) ...... 150 c.c. (f℥v).
M. Sig.: One or two tablespoonfuls (in *insomnia due to excessive nervous irritability*).

(*d*) ℞ Chloralis hydratis .... 2.5 grams (gr. xxxviij);
Sodii bromidi .... 4 grams (ʒj);
Syrupi codeinæ (N. F. IV) .... 45 c.c. (f℥iss);
Aquæ laurocerasi .... 4 c.c. (fʒj);
Aquæ tiliæ .... 80 c.c. (f℥iiss).
M. Sig.: One tablespoonful hourly until the desired effect is obtained (CHARCOT).

(*e*) *Bromidia.*—Each teaspoonful contains:
Extracti hyoscyami,
Extracti cannabis ....āā 0.01 gram (gr. ⅙);
Sodii bromidi,
Chloralis hydratis ....āā 1 gram ((gr. xv).
Dose: One to three teaspoonfuls.

(*f*) Addition of a small amount of *chloral hydrate reinforces the diuretic action of caffeine*. Thus, one may prescribe:

℞ Caffeinæ .... 0.4 gram (gr. vj);
Sodii benzoatis .... 2 grams (ʒss);
Chloralis hydratis .... 0.5 gram (gr. viiss);
Syrupi aurantii florum .... 30 c.c. (f℥j);
Aquæ destillatæ ....q. s. ad 90 c.c. (f℥iij).
M. Sig.: To be taken in the course of 24 hours.

Again, there are certain *incompatibilities* with which one should be thoroughly familiar. Chloral hydrate should be combined neither with alkalies, on account of the possibility of decomposition of the chloral with liberation of chloroform and formates, nor with the bromides in an alcoholic solution, with which it does not mix. It

cannot be prescribed in powders or cachets with any of the following drugs: Antipyrin, menthol, phenyl salicylate, thymol, acetphenetidin, or camphor, with which it forms liquids. With antipyrin in solution it yields a precipitate of hypnal.

BARBITAL (VERONAL).

(*a*) ℞ Acetphenetidini,
Barbitali ....āā 0.3 gram (gr. v).
Ft. cachet. No. i. Da tal. No. xii.
Sig.: One cachet on retiring. (For *insomnia due to pain.*)

(*b*) Sodium-barbital and fluidextract of valerian (valeronal).

(*c*) ℞ Barbitali .... 0.2 gram (gr. iij);
Extracti hyoscyami .... 0.02 gram (gr. 1/3);
Extracti valerianæ .... 0.1 gram (gr. iss).
Ft. cachet. No. i.

BROMOFORM:

℞ Bromoformi .... 1.5 c.c. (♏xxiv);
Alcoholis .... 60 c.c. (f℥ij);
Tincturæ belladonnæ,
Tincturæ aconiti ....āā gtt. xxx;
Syrupi codeinæ (N. F. IV) ...q. s. ad 200 c.c. (f℥vij).
M. Sig.: One to four tablespoonfuls in 24 hours. (For *insomnia due to cough.*)

E.—ANALGESIC HYPNOTICS.

OPIUM.—*Papaver somniferum* (Papaveraceæ).—Opium, with its derivatives, is the most important substance in the materia medica.

It allays the two commonest and most distressing symptoms with which the therapist has to deal, *viz.*, **pain** and **sleeplessness.**

It also contributes to the relief of two other symptoms almost as common and hardly less distressing, *viz.*, **cough** and **diarrhea.**

Analgesic, hypnotic, cough sedative, and antiexosmotic—such are the essential attributes of opium and its derivatives.

Opium also contributes to the *relief of dyspnea,* to *improving heart action,* etc.

* * *

Opium and morphine, its principal alkaloid, constitute the typical remedies for **pain,** their use, either temporary or continuous, being accordingly indicated in the *neuralgias* and *visceralgias,* of whatever cause and variety (hepatic or renal colic, trifacial neuralgia, tabetic or cancerous pains, etc.). The risk of habit formation, however, necessitates restriction of their use to pains that are either transitory (appendicitis), grave (cancer), or *in extremis* (agonal period).

As **hypnotics,** opium and morphine contrast with chloral hydrate.

Morphine is analgesic, while chloral is not.

Morphine in an initial stage induces brain excitement, whereas the sleep of chloral is not preceded by any period of excitement.

Opium and morphine are, rather, cardiovascular tonics; chloral is a blood-pressure-lowering cardiovascular depressant.

Accordingly, **opium and morphine are indicated in insomnia associated with neurovascular hyposthenia or pain; chloral hydrate, in insomnia associated with neurovascular hypersthenia in the absence of pain.**

As **cough sedatives,** opium and some of its derivatives, more particularly *codeine* and *dionin,* are standard remedies and lend themselves to numerous combinations with synergists (aconite, hyoscyamus, belladonna, cherry-laurel water, drosera, bromoform, etc.). They constitute the active agent in the majority of sedative syrups.

As an **antiexosmotic,** opium is used to antagonize conditions of hypersecretion, particularly in intestinal catarrh (diarrhea) and in bronchial catarrh (bronchitis with abundant secretion).

The **antidyspneic** action of opium (or morphine) is dependent upon a number of factors: 1. A heart stimulant and peripheral vasodilator action, whence the *relief of the dyspnea on exertion in aortic disease.* 2. It antagonizes, *in a measure, cerebral and bulbopontine anemia.* 3. It allays neuralgic conditions of the aortic and pulmonary plexuses, becoming thus the remedy of choice in *angina pectoris due to aortic disease.* 4. It exerts a selective *antidyspneic action on the respiratory center in the medulla,* whence the often remarkable relief afforded in the *paroxysmal dyspnea of essential asthma,* and sometimes in *uremic dyspnea* and in the terminal dyspnea of cases with extensive lung cavities and of pneumothorax.

Conversely, opium is **contraindicated** when there is a tendency to **cerebral hyperemia and stasis** (somnolence, incipient delirium), when there is some **hindrance to the pulmonary circulation** (mitral disease, catarrh, etc.) or manifestations of **bronchopulmonary paresis** (cyanosis, asphyxia, non-expulsive cough), and especially, when angina pectoris is complicated with dyspnea due to acute edema of the lungs.

In a general way, opium is *contraindicated:*

1. *In inflammatory and congestive states of the central nervous system, e.g.,* in *meningitis,* in which chloral and bromides should be preferred to it; in *fever,* in which the antipyretics should be preferred; in *overwork,* in which barbital and nyctal do better, and in *cerebral congestion,* with a *tendency to apoplexy,* in which venesection and purgation are more effective.

2. In *adynamic states,* and in particular, in adynamia accompanied by bronchopulmonary paresis, with a tendency to edema of the lungs, to cyanosis and asphyxia, and to dilatation of the right heart.

3. In *renal disorders,* especially those in which elimination through the kidneys is greatly reduced.

4. *Very young children* sometimes do not bear the opiates well.

Finally, although in some respects the antagonist of belladonna, opium nevertheless acts, like the latter drug, as an **antispasmodic** under many different circumstances. On this account it may be used in the muscular spasms of smooth muscle-tissue (**bronchial, digestive,** and **genito-urinary**), becoming thus a heroic remedy in *painful uterine spasm* (**abortion**), in *painful spasms of the intestine* or *bladder,* in *whooping-cough,* in *asthma,* etc.

* * *

UNTOWARD RESULTS FROM MORPHINE AND ITS DERIVATIVES.

OPIUM INTOXICATION presents, aside from certain differences, such symptomatic similarities to alcoholic intoxication both in its acute (acute poisoning, opium inebriety) and chronic forms (alcoholism, morphinism), as well as in its individual manifestations and social consequences (alcoholism among the white races, opium eating among the Asiatics), that the resemblance is at once apparent.

Acute Intoxication.—With both drugs, even moderate doses may give rise on the following day to various disturbances, such as headache, dryness of the mouth and nausea.

Larger doses frequently cause a *temporary psychic stimulation,* availed of to advantage by a few authors (De Quincey, Verlaine, Musset, etc.), with increased physical activity and accelerated heart action, followed by a *state of somnolence* with *diminution of the sensory functions* followed in turn by *sleep.*

Still larger amounts—varying, however, according to the degree of habituation of the subject—shorten the period of stimulation, make the sleep quicker in onset and deeper, and terminate in a state of *coma* with abolition of the reflexes and stertorous respiration, the similarity of which in the two cases (alcohol and opium) is often sufficiently marked to render the diagnosis difficult. In alcoholic poisoning, however, the pupils are dilated, the pulse full but soft, and the skin, if anything, unusually warm; in opium poisoning the pupils are generally strongly contracted (opium myosis), the pulse weak and irregular, and the skin cold and clammy.

The eventual termination is the same: Either the respiration and the circulation improve, the sleep becomes more natural, and the patient is restored to life, or, on the other hand, the pulse becomes increasingly feeble, respiration is embarrassed, and the patient dies either in sudden collapse or after a period of clonic and tonic convulsions.

Such is, in brief, the clinical picture of acute intoxication by either opium or alcohol.

Chronic Intoxication.—*Morphinism* or chronic opium intoxication likewise presents marked points of similarity with alcoholism, and the clinical picture Lancereaux gave some time ago of morphinism, and to which one cannot do better than refer, is applicable in almost all its features to alcoholism. Morphinism is manifested, in the order given:

1. By an *imperative need of morphine,* resulting from the property possessed by it of inducing, after the period of stimulation, a state of depression from which a fresh dose of morphine can alone relieve the patient, so that in the treatment of morphinism the withdrawal of the drug is capable of causing the so-called "abstinence symptoms" (heart weakness, digestive disturbances, albuminuria, nervous disturbances, insomnia, and asthenia), of which but one is really attended with danger, *viz.,* cardiac insufficiency.

2. By *digestive disturbances,* consisting of anorexia, dryness of the mouth, constipation, and later diarrhea.

3. By *nervous disturbances,* consisting of brain stimulation with disorder and lack of equilibrium of its functions, diminution of the sensory functions and of memory, perversion of percepts, producing a species of imaginative delirium, and an impairment of the affective faculty and of the moral sense. Hallucinations are uncommon and the special senses involved only late. Tremor and abolition of the tendon-reflexes may be observed.

4. By *disturbances of body nutrition:* Loss of weight, emaciation, a yellow, earthy color of the skin, muscular atrophy, etc.

5. By *disturbances of the reproductive function:* Absence of sexual desire, amenorrhea, sterility in the female, and impotence in the male.

NARCOTICS.

PREPARATIONS.

1. Powdered Opium [*Opium pulveratum,* U. S. P.], 0.1 gram (1½ grains) in a pill.—Two to six pills a day.—For *diarrhea.*

[*Opium,* U. S. P., 0.06 gram (1 grain).

Opium granulatum, U. S. P., 0.06 gram (1 grain).

2. EXTRACT OF OPIUM [*Extractum opii,* N. F., 20 per cent. of morphine; 0.03 gram (½ grain)], 0.02 gram (⅓ grain) in a pill.—Two to ten pills a day.—For *pain in the abdomen.*

3. TINCTURE OF OPIUM [*Tinctura opii,* U. S. P., 1 per cent. of morphine; 0.6 c.c. (10 minims).

4. MORPHINE:

(*a*) Syrup of morphine (French Codex), containing 0.01 gram (⅙ grain) of morphine per tablespoonful.—Two to six tablespoonfuls a day.—For *cough, pain,* or *sleeplessness.*

(*b*) A solution may be procured in ampules, each containing 0.01 gram (⅙ grain) of morphine, for hypodermic injections.—One to six a day.—For *pain* and *sleeplessness due to pain.*

[*Morphinæ hydrochloridum,* U. S. P., 0.008 gram (⅛ grain).

Morphinæ sulphas, U. S. P., 0.008 gram (⅛ grain).

Morphina, U. S. P. IX, 0.008 gram (⅛ grain).

Syrupus morphinæ et acaciæ, N. F. IV, Jackson's pectoral syrup; morphine hydrochloride, 0.055, and oil of sassafras, 0.05, in syrup of acacia, to make 100. Dose, 4 c.c. (1 fluidram).]

5. CODEINE:

(*a*) Syrup of codeine [*Syrupus codeinæ,* N. F. IV], 0.03 to 0.04 gram (½ to ⅔ grain) of codeine to the tablespoonful.—Two to five tablespoonfuls a day.—For *cough.*

(*b*) ℞ Codeinæ .... 0.01 gram (gr. ⅙);
Terpini hydratis .... 0.1 gram (gr. iss));
Saponis .... q. s.
Ft. pil. No. i. Da tal. No. xx.
Sig.: Two to five pills a day. (For *cough* and *expectoration.*)

[*Codeina,* U. S. P., 0.03 gram (½ grain).

Codeinæ phosphas, U. S. P., 0.03 gram (½ grain).

Codeinæ sulphas, U. S. P., 0.03 gram (½ grain).

Syrupus codeinæ, N. F. IV, codeine sulphate, 0.2, in syrup, to make 100. Dose, 4 c.c. (1 fluidram).]

6. ETHYLMORPHINE HYDROCHLORIDE (DIONIN) [*Æthylmorphinæ hydrochloridum,* U. S. P., 0.015 gram (¼ grain)]:

℞ Æthylmorphinæ hydrochloridi .... 0.3 gram (gr. v);
Aquæ laurocerasi .... 10 c.c. (f℈iiss);
Aquæ chloroformi ....q. s. ad 100 c.c. (f℥iiiss).
M. Sig.: Three to six teaspoonfuls a day. (For *cough.*)

7. DIACETYLMORPHINE (HEROIN) [*Diacetylmorphinæ hydrochloridum,* U. S. P. IX, 0.003 gram (1/20 grain)]:

℞ Diacetylmorphinæ hydrochloridi .... 0.1 gram (gr. iss);
Aquæ laurocerasi .... 20 c.c. (f℥v).

M. Sig.: Twenty drops three or four times a day in a little water sweetened with sugar. (For *refractory cough.*)

8. PANTOPON (PANTOPIUM).

This is an unofficial purified mixture of the opium alkaloids, containing 50 per cent. of morphine; 0.02 gram (1/3 grain) of pantopon is equivalent to 0.01 gram (1/6 grain) of morphine.

(*a*) Hypodermic route:

1 c.c. (16 minims) = 0.02 gram (1/3 grain) of pantopon, for one dose.

2 to 4 c.c. (32 to 64 minims) = 0.04 to 0.08 gram (2/3 to 1 1/3 grains) of pantopon, *per diem.*

(*b*) Oral route:

0.01 to 0.03 gram (1/6 to 1/2 grain) a day.

Drug Combinations.

1. SYDENHAM'S LAUDANUM.

This is a tincture of opium with aromatics, containing 10 per cent. of powdered opium, *i.e.,* 1 per cent. of morphine. The maximum single dose is 2 c.c. (30 minims) and the maximum daily amount, 6 c.c. (90 minims).

[*Tinctura opii crocata,* N. F., tincture of opium with saffron, or Sydenham's laudanum. Represents granulated opium, 10; saffron, 2.5; cinnamon, 0.6; clove, 0.6, and diluted alcohol, to make 100. Average dose, 0.6 c.c. (10 minims).]

2. PAREGORIC.

A tincture of opium with camphor, oil of anise and benzoic acid.

[*Tinctura opii camphorata,* U. S. P., representing powdered opium, camphor, oil of anise and benzoic acid, of each 0.4, in a mixture of glycerin, 4, and diluted alcohol, to make 100. Average dose, 4 c.c. (1 fluidram).]

(*a*) Sixty drops [about 28 minims] of paregoric may be given five to ten times a day in a little sweetened water, for *colic* and *diarrhea.*

(*b*) ℞ Tincturæ opii camphoratæ .... gtt. xxx;
Benzonaphtholis .... 0.5 gram (gr. viiss);
Syrupi cydoniæ (quince) .... 8 c.c. (f℥ij);
Aquæ cinnamomi .... 50 c.c. (f℥xiiiss).—M.

The above preparation is intended for use in *colic* and *diarrhea in children.*

OPIUM AND ITS DERIVATIVES.

COMPOUNDS.	PREPARATIONS.	MAXIMUM DOSES.		PHARMACOLOGIC ACTION.	CLINICAL INDICATIONS.	CONTRAINDICATIONS.
		Single.	*Daily.*			
OPIUM. **Powdered opium.**	Pills.	0.2 gram	0.6 gram	Particularly: Analgesic (for viscera, digestive tract). Intestinal antiexosmotic. Narcotic.	*Gastralgia.* *Colic.* *Diarrhea.* *Peritonitis.*	
EXTRACTS. **Extract of opium.**	Pills.	0.1 gram	0.3 gram	Particularly: Analgesic. Hypnotic.	*Do.* *Neuralgia.* *Sleeplessness due to pain.* *Diabetes mellitus.*	
Pantopon. (50% morphine).	Tablets, 0.01 gram. Ampules, 0.02 gram, for hypodermic injection.	0.04 gram	0.12 gram			1. **Inflammatory and congestive condition of the nervous system:** *Meningitis.* *Fever.* *Overwork.* *Cerebral congestion.* *Apoplectic tendency.*
MORPHINE. **Hydrochloride and sulphate.**	Powder. Tablets for hypodermic injection.	0.02 gram	0.08 gram	Analgesic. Hypnotic. Cough sedative.	*Rebellious pain.* *Insomnia due to pain.* *Exhausting cough.* *Asthmatic dyspnea.*	
Ethylmorphine hydrochloride (dionin).	Tablets. Solutions.	0.05 gram	0.12 gram	Mainly cough sedative.	*Rebellious pain.* *Tracheo-laryngeal cough.*	2. **Adynamic bronchopulmonary conditions.** *Tendency to cyanosis.* *Pulmonary edema.* *Asphyxia.* *Heart failure.*
Diacetylmorphine (heroin) hydrochloride.	Tablets. Liquid preparations. Solution for hypodermic injection.	0.006 gram	0.025 gram	Mainly narcotic.	*Insomnia due to pain.*	3. **Renal affections with functional insufficiency.**

CODEINE. **Alkaloid, phosphate, and sulphate.**	Powder. Pills. Liquid preparations. Syrup, N. F. IV (0.2 per cent.).	0.06 gram	0.25 gram	Mainly cough sedative.	*Cough.* *Dyspnea (together with iodides).*	**Equivalent Quantities:** 0.01 gram morphine. 0.02 " pantopon. 0.05 " extract of opium. 0.1 " powdered opium. 1 " laudanum (=43 drops). 1 " Dover's powder. 25 " paregoric.
LAUDANUM. **Tincture of opium.**	Liquid prescriptions. Drops for oral ingestion and enemas. External applications.	2 c.c.	6 c.c.	Mainly analgesic to viscera (digestive tract, uterus, bladder).	*Intestinal colic.* *Uterine colic.* *Diarrhea.*	
PAREGORIC. **Camphorated tincture.** (0.4% powdered opium).	Ingested as such.	15 c.c.	30 c.c.	Mainly analgesic to digestive tract.	*Gastralgia.* *Cramps.* *Diarrhea.*	
DOVER'S POWDER. **Powder of ipecac and opium** (10% each).	Powders. Pills. Cachets.	1 gram	4 grams	Mainly cough sedative and expectorant.	*Bronchitis with insistent cough and difficulty in expectoration.*	
Tincture of ipecac and opium, N. F. (full strength tincture of deodorized opium + 10% fluidextract of ipecac).	Liquid prescriptions.	1 c.c.	4 c.c.	Do.	*Do.*	
Syrup of ipecac and opium, N. F. (8.5% of preceding tincture).	Liquid prescriptions.	10 c.c.	40 c.c.	Do.	*Do.*	

(*c*) ℞ Pulveris ipecacuanhæ et opii,
Quininæ dihydrochloridi,
Sodii benzoatis,
Terpini hydratis ....āā 0.05 gram (gr. ¾).
Ft. pil. No. i. Da tal. No. xxx.
Sig.: Four to six pills a day, between meals. [For *tracheobronchial infections with fever and cough.*]

3. Dover's Powder:

[The following is a (French) modified formula for this powder, the potassium salts being substituted for the milk sugar of the U. S. P. preparation]:

℞ Ipecacuanhæ pulveris,
Opii pulverati ....āā 0.1 gram (gr. iss);
Potassii sulphatis,
Potassii nitratis ....āā 0.4 gram (gr. vi).—M.

Dover's powder may be given in powders or cachets, for sedative, diuretic, expectorant or diaphoretic purposes.

4. Opium and Belladonna.—While physiologic antagonists in some respects, these drugs are synergists in others (see *Belladonna*).

(*a*) ℞ Extracti opii (N. F.),
Extracti belladonnæ ....āā 0.01 gram (gr. ⅙).
Ft. pil. No. i. Da tal. No. xx.
Sig.: Two to six pills a day. (For *cough, cramps,* and *intra-abdominal spasmodic conditions.*)

(*b*) ℞ Atropinæ sulphatis .... 0.01 gram (gr. ⅙);
Morphinæ hydrochloridi .... 0.1 gram (gr. iss);
Aquæ laurocerasi ....q. s. ad 10 c.c. (f℥iiss).
M. et sterilisa.
Sig.: For hypodermic injection (1 c.c.).

Atropine seems to prevent the nausea which morphine alone often causes. The foregoing solution is for injection in *hepatic* or *renal colic.*

5. Chloral Hydrate and Morphine:

℞ Syrupi chloralis hydratis (5 per cent.),
Syrupi morphinæ (0.05 per cent.) ....āā 90 c.c. (f℥iij).
M. Sig.: One to six tablespoonfuls. (For *insomnia with pain in excited subjects.*)

6. Ether and Morphine:

℞ Syrupi ætheris (2 per cent. by weight),
Syrupi morphinæ (0.05 per cent.) ....āā 90 c.c. (f℥iij).
M. Sig.: One to four tablespoonfuls. (For *pain* in depressed, dyspneic subjects.)

7. MORPHINE AND ANALGESICS:

℞ Morphinæ hydrochloridi .... 0.01 gram (gr. 1/6);
Antipyrinæ,
Sodii bicarbonatis,
Acidi tartarici ....āā 1 gram (gr. xv);
Lactosi .... 5 grams (gr. lxxv).
Pone in chart. No. i. Da tal. No. vi.
Sig.: One to four powders in 24 hours in a half glassful of water. (For *obstinate neuralgia,* trigeminal in particular.)

8. SEDATIVE SUPPOSITORIES:

℞ Morphinæ hydrochloridi .... 0.01 gram (gr. 1/6);
Chloralis hydratis,
Sodii bromidi,
Ceræ albæ ....āā 1 gram (gr. xv);
Olei theobromatis .... 5 grams (gr. lxxv).
Ft. suppos. No. i. Da tal. No. vi.
Sig.: Insert one to three in 24 hours. (For *insomnia due to pain, irritability of meningeal origin,* or *pain in the bladder with tenesmus.*)

F.—ANESTHETICS.

Little will be said here concerning the anesthetics, as anesthesia, both local and general, is to be considered separately in a later section of this work.

An important feature definitely distinguishes the general anesthetics of the type of chloroform, ether or nitrous oxide from the analgesics of the type of antipyrin or the hypnotics of the type of chloral hydrate, *viz.,* the fact that they are gaseous narcotics which are absorbed rapidly through the lungs into the blood and exert a selective action on the upper psychic centers (producing sleep), on the upper sensory centers (producing the anesthesia), and only in the last instance on the respiratory and cardiac centers in the medulla (whence the relative safety of the anesthesia induced by these agents).

The discovery of anesthesia and that of antisepsis constituted a necessary foundation for the remarkable advances in surgery made in the course of the second half of the last century. It was precisely in harmony with medical endeavor to try to at least reduce the sensibility of the patient during painful operations: Alcohol, opium and mandragora seem to have been employed in all ages for this purpose; various wines containing opiates procured a relative "numbing" of sensibility, which was availed of to advantage by the operators.

The general anesthetics now in current use are ether, chloroform, ethyl chloride and ethyl bromide. Nitrous oxide, which once had its period of vogue and celebrity, has been again brought to the

front in late years; it affords a high degree of safety, and seems destined to undergo a veritable renaissance. Anesthesia with chloralose does not appear as yet to have gotten beyond the experimental stage.

II.—NERVOUS STIMULANTS.

STRYCHNINE AND NUX VOMICA. *Strychnos nux vomica* (Loganaceæ).—Discovered in 1818 by Pelletier and Caventou, strychnine is extracted either from nux vomica or from ignatia.

In therapeutic doses, with which we are here alone concerned, and from the exclusive standpoint of clinical therapeutics, strychnine may be described as one of the *most powerful stimulants,* if not *the most powerful* stimulant of the nervous system, respiration, and heart.

Physiologically this action finds its expression *in the central nervous system* in an *increase of reflex irritability,* which increase is especially pronounced for mechanical stimuli (jarring, contact, noises, etc.), more pronounced for the extensor than for the flexor movements, and which seems to extend regularly from above downward, from the muscles of the head and neck to those of the trunk and lower extremities; with toxic doses, there is produced an actual experimental tetanus, typical and in most instances fatal.

Reflex excitability affording, on the whole, the most general type of reaction on the part of the nervous system, and that which holds under its sway, more or less directly, the major organic functions (nutrition, respiration and circulation), an increase in this reflex excitability—kept within normal bounds, however—constitutes in the last analysis a *general stimulation of the organism.*

Strychnine exerts a marked stimulant action on the heart as well as more generally on the circulation.

Again, it is a very powerful stimulant to the respiratory center.

As **subsidiary nervous stimulants** mention may be made, merely to refresh the memory, of the following agents:

The *diffusible stimulants* (see *Drugs Acting on the Circulation*).

The *alkaloidal beverages:* Tea, coffee, kola, etc.

Phosphoric acid and the *phosphorus compounds* (see *Nerve Tonics*).

Arsenic and *cinchona.*

The indication for strychnine is neuro-cardiovascular asthenia.—The indications for strychnine suggest themselves very naturally from the foregoing pharmacodynamic properties; it is a ***drug of choice in nervous, circulatory and respiratory asthenia.***

Strychnine is, perhaps, the most valuable cardiovascular stimulant known. It enhances and accelerates the cardiac contractions and considerably raises the blood-pressure through contraction of the vessels. Adding to this the increase of reflex irritability, one sees that it must be one of the most powerful of neuro-cardiovascular stimulants. [Recent experimental work and clinical tests have suggested that the increase of reflex irritability is perhaps the main source of the beneficial effects of strychnine on the circulation. Marked vasomotor stimulation by strychnine occurs in the presence of asphyxia, but no pronounced direct stimulation of the heart-muscle or vessel-walls seems ordinarily to occur.—TR.]

The two essential indications for the use of strychnine are *nervous asthenia* and *cardiovascular asthenia*—conditions which are often combined.

For this twofold reason, it may be used with marked success in *all acute infections accompanied by adynamia,* low blood-pressure and a tendency to dilatation of the right heart and collapse, such as pneumonia, typhoid fever, acute tuberculosis, acute peritonitis, and especially influenza—a weakening disorder *par excellence.* It has often proven very serviceable in conditions of shock, traumatic or postoperative.

It is likewise very useful in *heart disease in the period of functional insufficiency,* whatever be its cause. An essential indication, however, is low blood-pressure, for, since one of the first stages of its action is actually manifested in a rather abrupt rise of the blood-pressure, there would be some risk of exaggerating the loss of cardiovascular balance were it to be given in heart cases with a normal or supranormal blood-pressure. [This feature may, however, have been overemphasized, as a considerable proportion of clinical tests with strychnine have shown no pronounced effect on the blood-pressure.—TR.]

In the *acute stages of infections,* in profound neurocardiac enfeeblement, as in traumatic or operative shock, in the asthenic form of influenza with tendency to cardioplegia, pulmonary stasis, and consolidation at the bases of the lungs, and in adynamic pneumonia cases, *rapid and powerful action is required;* it may be necessary to employ rather large doses, such as 0.003 to 0.005 gram ($1/20$ to $1/12$ grain), and to repeat them on occasion, under careful observation, two or three times in the 24 hours, for a few days. *The administration of the drug,* being adapted to the existing symptoms, *should be energetic though temporary, relatively large and frequently repeated doses being used.*

On the other hand, in conditions with *chronic weakness,* in heart cases in the stage of functional insufficiency, in pulmonary tuberculosis, in neur-

asthenia, and in depressive psychoneuroses, one is not dealing with an acute, threatening and temporary symptom, but with a chronic morbid condition, not immediately alarming, but refractory and persistent. *The administration of the drug is accordingly to be continuous or nearly so, and the dosage moderate.*

The use of strychnine has been advised in the *muscular depression* following intensive bromide treatment and, in particular, in *relaxation of the sphincters.*

Lastly, more or less successful results may, in general, be expected from it when it is used as an *excitomotor in conditions of paralysis, or more particularly of paresis, of the voluntary muscles* (diphtheritic paralysis, infantile paralysis, facial or ocular paralyses, etc.) *as well as of the involuntary muscles* (myocarditis, bronchoplegia, gastrointestinal atony, atony of the bladder, incontinence of urine, etc.).

As a *bitter stomachic* through stimulation of the salivary and gastric secretions it is frequently used in the treatment of the various forms of *anorexia,* including, in particular, the anorexia of tuberculous cases.

A point worthy of note is that recent observers have found that administration of strychnine brings about a pronounced and persistent increase of *adrenal secretion.*

* * *

Dosage of Strychnine.—If it be regarded, as stated by Gubler, that in the administration of strychnine "it is often necessary to push the dosage to the point of physiologic effects," one may assert:

1. That 0.005 to 0.015 gram (1/12 to 1/4 grain) constitutes the useful, moderate and easily handled *daily* dose in strychnine administration.

2. That 0.002 to 0.003 gram (1/30 to 1/20 grain) constitutes the useful and convenient *fractional* dose.

3. That by giving progressively ascending, fractional doses, beginning with 0.003 gram (1/20 grain) as the daily dose, testing the susceptibility of the patient and taking tolerance into account, one can, if necessary, gradually increase the dose in some subjects to 0.03 gram (1/2 grain).

4. That while many reports show that in some individuals, and particularly in some morbid conditions, such as alcoholic delirium, it has been possible to increase the doses up to 0.05 gram (3/4 grain) and more, the consensus from the aggregate of records is that above 0.03 gram one enters into a zone of actual danger.

5. That one must, however, always take idiosyncrasies and instances of unusual susceptibility into account, and in a new patient whose degree of tolerance is unknown, should begin with the above-

mentioned "pusillanimous" fractional dose of 0.002 gram (1/30 grain), increasing the amount rapidly thereafter when his tolerance has been ascertained.

The "ordinary maximum dose," not to be exceeded without special note of the fact to the druggist on the prescription, is given in the French Codex as 0.005 gram (1/12 grain) for the single dose and 0.015 gram (1/4 grain) for the daily amount of alkaloidal strychnine, and the corresponding quantities for the more commonly used strychnine sulphate as 0.006 gram (1/10 grain) and 0.018 gram (3/10 grain), respectively.

MODES OF ADMINISTRATION.

Strychnine Sulphate.

GRANULES of strychnine sulphate each containing 0.001 gram (1/65 grain) may be given to the number of 1 to 12 a day, according to tolerance. (For *neuro-cardiovascular asthenia.*)

LIQUID PREPARATION:

℞ Strychninæ sulphatis .... 0.05-0.1 gram (gr. 3/4-iss);
Syrupi aurantii amari .... 240 c.c. (f℥viij).

M. Sig.: One dessertspoonful three times a day before meals. (In *tuberculosis, anorexia,* or *neurasthenia.*)

SOLUTION FOR HYPODERMIC INJECTION:

℞ Strychninæ sulphatis .... 0.03 gram (gr. ss);
Aquæ destillatæ bulliatæ .... 10 c.c. (f℥iiss).

S. Sig.: 1 to 5 c.c. (16 to 80 minims) a day, injected hypodermically (with the patient under observation). (For *shock, acute nervous and circulatory depression.*)

SALINE SOLUTION WITH STRYCHNINE:

℞ Strychninæ sulphatis .... 0.01 gram (gr. 1/6);
Sodii sulphatis .... 0.3 gram (gr. v);
Sodii chloridi .... 0.5 gram (gr. viiss);
Aquæ destillatæ bulliatæ .... 100 c.c. (f℥xxvij).

M. Sig.: For hypodermic injections—20 to 50 c.c. (5 to 13 fluidrams) or more in 24 hours. (*Traumatic, post-hemorrhagic* or *post-operative shock.*)

Combinations:

(*a*) ℞ Strychninæ sulphatis .... 0.04 gram (gr. 2/3);
Sodii arsenatis .... 0.1 gram (gr. iss);
Aquæ destillatæ .... 150 c.c. (f℥v).

M. Sig.: One teaspoonful at the beginning of each meal.

(*b*) ℞ Strychninæ sulphatis .... 0.04 gram (gr. ⅝);
Sodii arsenatis (N. F.) .... 0.1 gram (gr. iss);
Sodii glycerophosphatis (N. F.) .... 10 grams (ʒiiss);
Fluidextracti cinchonæ .... 20 c.c. (fʒv);
Spiritus vini vitis .... 40 c.c. (fʒx);
Glycerini ....q. s. ad 150 c.c. (f℥iij).

M. Sig.: One teaspoonful at the beginning of each meal in a little water or other beverage. (*Slow convalescence, influenza sequelæ, pulmonary tuberculosis,* etc.)

(*c*) ℞ Strychninæ sulphatis .... 0.001 gram (gr. 1/65);
Sparteinæ sulphatis .... 0.01 gram (gr. ⅙);
Extracti ergotæ aquosi (N. F.) .... 0.05 gram (gr. ¾);
Quininæ sulphatis .... 0.1 gram (gr. iss).

Ft. pil. No. i. Da tal. No. xl.
Sig.: Six to eight pills daily. (*Bronchopulmonary infections with weakness and tendency to bronchoplegia.*)

(*d*) A much-used unofficial preparation contains, in each cubic centimeter:

Strychnine cacodylate .... 0.0005 gram (gr. 1/130);
Sodium glycerophosphate .... 0.1 gram (gr. iss).

(*e*) Another contains:

Strychnine cacodylate .... 0.001 gram (gr. 1/65);
Sodium methylarsenate,
Sodium nucleinate ....of each 0.05 gram (gr. ¾).

[(*f*) *Elixir ferri, quininæ et strychninæ,* N. F., including 0.875 per cent. of quinine hydrochloride and 0.0175 per cent. of strychnine sulphate. Average dose, 4 c.c. (1 fluidram).]

Nux Vomica:

The TINCTURE contains approximately 0.25 per cent. of the total alkaloids of nux vomica. The maximum single dose is 2 c.c. (30 minims) and the maximum daily dose, 5 c.c. (75 minims).

[*Tinctura nucis vomicæ,* U. S. P., 1 c.c. (15 minims).

Extractum nucis vomicæ, U. S. P., 16 per cent. of alkaloids; 0.015 gram (¼ grain).

Fluidextractum nucis vomicæ, N. F., 0.1 c.c. (1½ minims).]

℞ Tincturæ nucis vomicæ,
Tincturæ cascarillæ,
Tincturæ calumbæ
Tincturæ gentianæ ....āā 5 c.c. (♏lxxx).

Filtra et adde:
Acidi citrici .... q. s.

Sig.: Twenty to forty drops in a little water before eating. (For *anorexia* or *gastrointestinal atony.*)

In the foregoing prescription enough citric acid is to be added to yield a clear tincture.

Administration of Strychnine in Ascending Doses.—This procedure is particularly indicated as the treatment of choice for nerve tonic purposes in *chronic nervous asthenia, neurasthenia* and *depressive psychoneuroses.*

One may inject in ascending amounts, and according to tolerance, 1 to 10 c.c. (16 to 160 minims) of a sterile 0.1 per cent. solution. A convenient method is to have prepared 24 ampules of 1 c.c. each containing 16 different doses of strychnine ranging from 0.001 to 0.01 gram ($\frac{1}{64}$ to $\frac{1}{6}$ grain), with which the ascending dosage is carried out thus:

I. First, 4 ampules with *small doses* of 0.001 to 0.004 gram ($\frac{1}{64}$ to $\frac{1}{16}$ grain) of strychnine.

On the *first day* of the treatment, the contents of the 0.001 gram ampule is injected, and the dose increased by the same amount on the three succeeding days, up to 0.004.

II. Next, 4 ampules with *intermediate doses* of 0.0045 to 0.006 gram ($\frac{1}{14}$ to $\frac{1}{11}$ grain) of strychnine.

On the *fifth day* of the treatment, the contents of the 0.0045 gram ampule is injected, with an increase thereafter of 0.0005 gram a day, thus reaching gradually the dose of physiologic reaction.

III. Finally, 16 ampules with the *large doses* of 0.0065 to 0.01 gram ($\frac{1}{10}$ to $\frac{1}{6}$ grain), increasing thereafter by 0.0005 gram, but with each dose given twice, *i.e.*, on two successive days, in order to secure gradual tolerance.

With these doses a few abnormal sensations may sometimes be experienced, such as a slight degree of "intoxication," in no way unpleasant, slight dizziness, and some stiffness of the jaws and lower extremities. These slight disturbances are in no wise serious and, when they occur, disappear very quickly if the patient takes care to sit down or lie down for a short time after receiving the injection.

III.—NERVE TONICS.

PHOSPHORUS COMPOUNDS.—**Phosphorus** in various forms (phosphates, lipoids, lecithin, etc.) is an integral part of the body tissues. Phosphorus dietetics and medication are still the subject of many controversies and uncertainties.

All that can be said—and that is not much—is that phosphoric katabolism, while varying within very wide limits even under normal conditions, is nonetheless constantly going on, and that, therefore, the phosphates should form a definite part of the normal diet; that clinically there are a number of physiologic states (pregnancy, lactation, etc.) or morbid states (tuberculosis, infectious diseases in

general, overstrain, states of mental depression, chlorosis, etc.) in which loss of mineral constituents, and of phosphorus in particular, from the body structures overbalances the processes of assimilation; that, on the other hand, there is a considerable period of life, *viz.*, youth, in which the processes of assimilation, and in particular those pertaining to phosphorus, must outweigh those of disassimilation, and lastly, that a condition of defective assimilation of phosphorus (growth disturbances) can occur.

In short, **the phosphates must form part of the normal diet**; the amount of phosphates taken should be large in the physiologic cases in which the adult mineralization of the tissues is not yet completed (youth) or the phosphates are being used up more rapidly (pregnancy and lactation), as well as in the abnormal cases in which phosphatization shows itself clinically to be insufficient (rickets) or dephosphatization is exaggerated (infectious diseases, tuberculosis, overwork, chlorosis, nervous depression, or convalescence).

MODES OF ADMINISTRATION.

PHOSPHORUS:

Codliver oil containing 1:20,000 of phosphorus may be used in a daily dosage of two to eight teaspoonfuls. (*Rickets. Impotence.*)

PHOSPHORIC ACID:

1. From 1.25 to 12.5 c.c. (20 to 200 minims) of the official diluted acid [*Acidum phosphoricum dilutum*, U. S. P., 10 per cent. of H_3PO_4] may be taken after meals in a little water sweetened with sugar or a cupful of some simple infusion.

2. ℞ Acidi phosphorici diluti .... 36 c.c. (f℥ix);
Sodii biphosphatis .... 20 grams (℥v);
Aquæ destillatæ ....q. s. ad 210 c.c. (f℥vij).

M. Sig.: One to six teaspoonfuls after meals in a little sweetened water or a cupful of some simple infusion. (*Neurasthenia. Psychasthenia. Hyposthenic dyspepsia. Arthritis deformans. Phosphypostasis. Hypoacid diathesis.*)

PHOSPHATES:

1. The syrups of calcium lactophosphate or calcium hydrochlorophosphate may be given in *growth disturbances* and in *convalescence*.

[*Syrupus calcii lactophosphatis,* N. F., 10 c.c. (2½ fluidrams).
Syrupus calcii hydrochlorophosphatis, N. F. IV, 4 c.c. (1 fluidram).]

2. ℞ Calcii phosphatis præcipitati (N. F.) ... 0.6 gram (gr. ix);
Sodii chloridi .... 0.25 gram (gr. iv);
Magnesii oxidi .... 0.15 gram (gr. iss).

Pone in cachet. No. i. Da tal. No. xxx.
Sig.: One cachet with each meal. (*Demineralization. Tuberculosis.*)

3. ℞ Acidi tannici .... 0.2 gram (gr. iij);
Calcii phosphatis præcipitati (N. F.) .... 0.4 gram (gr. vj).
Pone in cachet. No. i. Da tal. No. xxx.
Sig.: One cachet with each meal. (*Convalescence. Tuberculosis. Diarrhea.*)

4. Sydenham's "white decoction":

℞ Calcii phosphatis (dicalcium) .... 10 grams (ʒiiss);
Acaciæ pulveris .... 20 grams (ʒv);
Syrupi .... 75 c.c. (f℥iiss);
Aquæ aurantii florum .... 20 c.c. (fʒv);
Aquæ destillatæ ....q. s. ad 1 liter (f℥xxxiij).
M. Sig.: *Ad libitum.* (*Diarrhea. Demineralization.*)

HYPOPHOSPHITES:

℞ Sodii hypophosphitis .... 5 grams (gr. lxxv);
Syrupi aurantii florum .... 40 c.c. (fʒx);
Syrupi .... 270 c.c. (f℥ix).
M. Sig.: One to four tablespoonfuls a day. (*Poor nutrition. Asthenia. Tuberculosis.*)

GLYCEROPHOSPHATES:

The glycerophosphates of calcium, sodium, magnesium, and iron may be prescribed in cachets, tablets, solutions, mixtures, elixirs, or by hypodermic injection in average doses of 0.25 to 1 gram (4 to 15 grains).

[*Calcii glycerophosphas,* U. S. P., 0.3 gram (5 grains).
Sodii glycerophosphas, N. F., 0.25 gram (4 grains).
Ferri glycerophosphas, N. F., 0.2 gram (3 grains).]

LECITHIN may be given in pills, capsules, or in oily solutions for hypodermic injection, in average doses of 0.1 to 0.5 gram (1½ to 7½ grains) a day.

(1) ℞ Lecithin,
Calcii glycerophosphatis ....āā 0.1 gram (gr. iss).
Ft. pil. No. i. Da tal. No. xxx.
Sig.: Three to five pills a day.

(2) ℞ Lecithin .... 5 grams (gr. lxxv);
Olei olivæ .... 100 c.c. (f℥iiiss).
Sterilisa.
Sig.: For hypodermic injection; 2 to 5 c.c. (32 to 80 minims) a day.

Tonic Combinations.—Strychnine, arsenic, the iron salts, the glycerophosphates, cinchona and kola are the agents most commonly used in tonic medication. They may be appropriately combined in accordance with the existing indications. Strychnine and kola are more especially neurovascular tonics; arsenic and iron enhance the formation of erythrocytes and hemoglobin and stimulate nutrition and blood regeneration; the glycerophosphates are nervine restoratives,

while cinchona is a general tonic, the action of which is not yet well elucidated, though established on the basis of centuries of empiric clinical use.

Taking a typical case, we may consider a smouldering, incipient tuberculous process, the clinical features of which, *viz.*, neurovascular asthenia with low blood-pressure, anemia and failing nutrition, nervous depression with phosphaturia, fever and sweats, and "lymphatism," correspond precisely with the foregoing indications; these indications may all be met with the following formula:

℞ Strychninæ sulphatis .... 0.001-0.003 gram (gr. 1/60-1/20);
Sodii arsenatis .... 0.002-0.003 gram (gr. 1/30-1/20);
Calcii glycerophosphatis,
Ferri protoxalatis,
Extracti cinchonæ ....āā 0.06 gram (gr. j).
Ft. pil. No. i. Da tal. No. lx.
Sig.: One pill three times daily with the meals.

This basic formula is subject to countless modifications and corrections, such as the following:

℞ Strychninæ sulphatis .... 0.001-0.003 gram (gr. 1/60-1/20);
Sodii arsenatis .... 0.002-0.003 gram (gr. 1/30-1/20);
Ferri protoxalatis,
Calcii glycerophosphatis,
Extracti cinchonæ,
Extracti rhei ....āā 0.05 gram (gr. ¾).
Ft. pil. No. i. Da tal. No. lx.
Sig.: One pill three times daily with the meals.

℞ Strychninæ sulphatis .... 0.001-0.003 gram (gr. 1/60-1/20);
Sodii monomethylarsenatis,
Calcii glycerophosphatis,
Quininæ dihydrochloridi,
Extracti rhei vel cascaræ sagradæ ...āā 0.05 gram (gr. ¾).
Ft. pil. No. i. Da tal. No. lx.
Sig.: One pill three times daily with the meals.

In this combination the rhubarb or cascara counteract the astringent effect otherwise likely to be exerted.

Following are formulas for a liquid mixture or solution and for hypodermic injection:

LIQUID MIXTURE:

℞ Strychninæ sulphatis .... 0.03-0.05 gram (gr. ss-¾);
Arrhenal .... 1 gram (gr. xv);
Sodii glycerophosphatis (N. F.) .... 10 grams (ℨiiss);
Extracti cinchonæ .... 20 grams (ℨv);
Spiritus vini vitis .... 60 c.c. (f℥ij);
Glycerini .... 45 c.c. (f℥iss);
Aquæ destillatæ ....q. s. ad 150 c.c. (f℥v).
Ft. sec. art.
Sig.: One teaspoonful, diluted, three times daily with the meals. (*Asthenia of convalescence, pretuberculosis,* etc.)

INJECTION:

℞ Strychninæ sulphatis	0.04	gram	(gr. ⅝);
Sodii cacodylatis	1	gram	(gr. xv);
Sodii glycerophosphatis	2	grams	(ʒss);
Aquæ destillatæ	20	c.c.	(fʒv).

Sterilisa.
Sig.: For hypodermic injection; 1 to 2 c.c. (16 to 32 minims) a day.

SOLUTION:

℞ Calcii glycerophosphatis .... 0.5 gram (gr. viiss).
Pone in chart. No. i. Da tal. No. xxx.
Sig.: One powder in a glass of Seltzer water at the noon and evening meals.

The first two of the above three preparations are to be preferred.

PHOSPHORUS AND ITS DERIVATIVES.

COMPOUNDS.	PREPARATIONS.	MAXIMUM DOSES.		PHARMACOLOGIC ACTION.	CLINICAL INDICATIONS.	CONTRA-INDICATIONS.
		Single.	*Daily.*			
Phosphorus P (To be handled with care).	Phosphorus in oil of expressed almond. 1% (Oleum phosphoratum, N. F.).	0.1 c.c.	0.2 c.c.	Aphrodisiac.	*Impotence.*	*Nervous excitement.*
	Codliver oil with phosphorus (1:-20,000).	20 c.c.	40 c.c.	Mineralizer.	*Rickets.*	*Digestive disturbances.*
Zinc phosphide. Zn_3P_2	Granules.	0.008 gram	0.016 gram	Do.	*Do.*	—
Phosphoric acid. H_3PO_4	Solutions. Drops. Mixtures.	According to tolerance.		Nerve tonic. Eupeptic. Neutralizes alkali.	*Asthenia. Psychasthenia. Atonic dyspepsia. Phosphypostasis. Arthritis deformans.*	*Nervous excitement. Gastric hypersecretion. Acid diatheses.*
Sodium phosphate. Na_2HPO_4	Solutions. Mixtures. Cachets.	*Ad libitum.*		Remineralizer. Roborant. Antidiarrheic.	*Bone disorders (rickets, growth disturbances, etc.).*	*Alkaline diatheses. Calcification processes. Atheroma.*
Calcium phosphate. $Ca(H_2PO_4)_2$, monocalcic. $Ca_2(HPO_4)_2$, dicalcic. $Ca_3(PO_4)_2$, tricalcic.	Syrupus calcii lactophosphatis, U. S. P. Syrupus calcii hydrochlorophosphatis, N. F.				*Demineralization. Tuberculosis. Neurasthenia.*	

Sodium hypophosphite. NaH_2PO_2 **Calcium hypophosphite.** $Ca(H_2PO_2)_2$	Syrups. Mixtures.	0.3 gram	1.5 gram	Do.	*Rickets. Tuberculosis.*	—
Sodium glycerophosphate. $Na_2PO_4C_3H_5(OH)_2 + H_2O$ **Calcium glycerophosphate.** $CaPO_4C_3H_5(OH)_2 + H_2O$ **Magnesium glycerophosphate.** $MgPO_4C_3H_5(OH)_2 + H_2O$	Solutions. Mixtures. Cachets. Hypodermic injection.	—	—	Nerve tonics. Nutritive tonics.	*Neurasthenia. Diabetes. Tuberculosis. Rickets. Phosphaturia. Convalescence.*	
Cereal phosphates.	Vegetable bouillon.	—	—	Do.	*Do.*	—
Lecithins. $C_{44}H_{90}O_2PN$	Pills. Capsules. Hypodermic injection.	0.25 gram	1 gram	Nerve tonic. Stimulant to nutrition.	*Do.*	*Cholelithiasis* (?).

VI

ALTERATIVES.

Only after some hesitation was it deemed expedient to devote a separate chapter to drugs acting on the metabolic processes, for while there are some agents which do produce metabolic changes, including specifically such as affect the metabolism of the carbohydrates, of fats, of proteins, of phosphorus, of calcium, etc. (alkalies, purgatives, acids, iodine, thyroid gland, etc.), from the pharmacologic standpoint **there are few drugs which act selectively in this connection,** so that it is more logical to defer consideration of these agents to the section dealing particularly with the *Metabolic diseases.*

Two groups of agents seemed, however, deserving of separate consideration here, *viz.,* **colchicum,** somewhat of a specific in gout, at least in respect of the acute attacks, and the **uricolytic drugs,** frequently employed in uricemia.

As for the other alterative drugs, they are either, like the alkalies, phosphoric acid, the iodine group, the arsenicals, etc., substances which have been considered in other sections on account of predominant actions of another sort; or nerve stimulants or depressants (phosphoric acid, antipyrin, the opium group, valerian, etc.) which act on metabolism only through the medium of the nervous system, or organotherapeutic products (thyroid, pituitary, ovary), all drugs which lend themselves more properly to classification elsewhere.

GOUT REMEDIES.

COLCHICUM. *Colchicum autumnale* (Liliaceæ).—The word colchicum is derived from the Greek κολχικόν: "Its origin was said to be Colchis, land of the terrible Medea, who was the first to make use of its poisonous properties" (H., Leclerc).

Colchicum may be considered the specific remedy for gouty pains.

Many theories have been proposed in explanation of its action; they are based on the fundamental and dominant physiologic properties of colchicum, which, in general, can be divided into three sorts, *viz., emetic* and *cathartic, analgesic,* and *alterative.* None of these theories, however, will bear careful scrutiny.

Accordingly, one is compelled to recognize that *colchicum acts on the pain manifestations of gout in a practically specific manner, but through a process as yet wholly unknown.*

* * *

Colchicum may be useful:

1. *During the attack of acute gout,* in which its inhibiting action is as unquestionable as that of digitalis in some heart disturbances.

2. In the interval between attacks, *at the time when the premonitory symptoms appear,* the drug being used—not always successfully—to forestall the oncoming attack.

3. In chronic gout, in which it has been held, when administered with great caution, to be capable of warding off the exacerbations. It is a point worthy of note that many gouty subjects, although manifestly relieved by colchicum during an acute attack, are nevertheless not very ready to take the drug in the succeeding attack. Judging from impressions gathered from many gouty subjects, it seems one may conclude that after an attack of acute gout has run its course and spontaneous recovery occurred, the patient generally feels himself restored to a normal state of health, whereas if the attack has been cut short by colchicum, a certain condition of malaise remains which is sometimes rather slow in disappearing.

* * *

The use of colchicum exposes the patient to serious dangers. The cases of fatal intoxication thus produced are innumerable. Its administration should be very carefully supervised.

When the patient receiving colchicum begins to experience gastrointestinal symptoms, and especially when he develops diarrhea, IMMEDIATE *cessation of the medication is imperative,* otherwise one is invariably courting trouble (Pouchet).

MODES OF ADMINISTRATION.

1. POWDERED COLCHICUM:

Colchicum seed may be prescribed as a powder or in pills or granules. The maximum single dose is 0.15 gram (2½ grains) and the daily dose ranges from 0.05 to 0.3 gram (¾ to 5 grains).

[*Colchici semen,* U. S. P., 0.45 per cent. of colchicine; average dose, 0.2 gram (3 grains).

Colchici cormus, U. S. P., 0.35 per cent. of colchicine; average dose, 0.25 gram (4 grains).]

2. EXTRACTS:

The maximum single dose of the extract is 0.05 gram (¾ grain) and the maximum daily dose, 0.2 gram (3 grains).

[*Extractum colchici*, U. S. P., 1.25 to 1.55 per cent. of colchicine; average dose, 0.06 gram (1 grain).

Fluidextractum colchici, U. S. P., 0.36 to 0.44 per cent. of colchicine; average dose, 0.2 c.c. (3 minims).]

3. TINCTURE:

The maximum single dose of the tincture of colchicum seed is 1.5 grams (about 26 minims) and the maximum daily dose, 6 grams (about 104 minims).

[*Tinctura colchici*, U. S. P., 0.036 to 0.044 per cent. of colchicine; average (and maximum) dose, 2 c.c. (30 minims).]

Method of descending doses (Lécorché):

First day: 100 drops [not minims] in 3 doses; second day, 100 drops; third day, 60 drops; fourth day, 40 drops.

Method of ascending doses:

First day, 40 to 60 drops; second day, 60 to 100 drops; third day, 100 to 150 drops, etc., according to effect and tolerance.

This cautious and certain procedure has much to recommend it.

4. COLCHICINE:

The maximum single dose of this alkaloid is 0.002 gram (1/30 grain) and the maximum daily dose, 0.004 gram (1/15 grain).

[*Colchicina*, U. S. P., average dose, 0.0005 gram (1/120 grain).]

In the acute gouty attack, colchicine treatment, as advised by Lécorché, may be planned thus:

Granules of 0.0005 gram (1/120 grain) of the alkaloid are used. First day, 4 to 6 granules; second day, 3 or 4; third day, 2 or 3; fourth day, 1 or 2. Then intermit for at least eight days.

5. COMPOUND PREPARATIONS.—All the empiric specifics for rheumatism or gout, or preparations reputed to be such, contain colchicum variously combined with synergists such as squill, bryonia, euonymus, xanthoxylum, guaiac, aconite, arnica, sodium benzoate, sodium salicylate, lithium salts, etc. It is a constituent, if not the main ingredient, of colchisal and of a number of old-time compound preparations.

Each capsule of colchisal contains 0.00025 gram (1/200 grain) of colchicine and 0.2 c.c. (3 minims) of methyl salicylate. It is used in the acute manifestations of gout in a dosage of 8 to 12 capsules a day.

The following combinations are specified in the "Formulaire des pharmaciens français":

℞ Extracti digitalis,
Extracti scillæ ....āā 0.01 gram (gr. 1/6);
Extracti colchici .... 0.025 gram (gr. 2/5);
Extracti colocynthidis .... 0.015 gram (gr. 1/4);
Quininæ sulphatis .... 0.1 gram (gr. iss).
Ft. pil. No. i. Da tal. No. xv.
Sig.: Three to six pills the first day; two or three on succeeding days.

℞ Lithii carbonatis (N. F.) .... 2 grams (ʒss);
Colchici cormi pulveris .... 20 grams (ʒv);
Bryoniæ pulveris,
Gentianæ pulveris,
Anthemidis pulveris ....āā 10 grams (ʒiiss);
Betonicæ pulveris .... 50 grams (℥iss).
M. et div. in chart. No. L.
Sig.: One powder a day in water.

Each of the above powders contains 0.4 gram (6 grains) of colchicum corm. The daily dose might instead be divided into four cachets.

ANTIGOUT PILLS:

℞ Extracti colchici .... 0.01 gram (gr. 1/6);
Digitalis pulveris .... 0.02 gram (gr. 1/3);
Pulveris ipecacuanhæ et opii,
Sodii benzoatis ....āā 0.05 gram (gr. 3/4);
Saponis .... q. s.
Ft. pil. No. i. Da tal. No. xxx.
Sig.: Four to six or more pills a day, according to tolerance.

ENEMA:

In the event of gastric intolerance, the drug may be prescribed thus:

℞ Tincturæ colchici .... 1 c.c. (♏xvj);
Tincturæ opii crocatæ (N. F.) .... gtt. x;
Decocti altheæ .... 80 c.c. (f℥iiss).
M. Sig.: For use as an enema, to be retained. (One or two such enemas may be administered in 24 hours.)

URICOLYTIC DRUGS.

These are the agents which favor reduction and elimination of uric acid.

ALKALIES.—Of these, *sodium bicarbonate* and *sodium benzoate* should be chiefly employed. It should not be forgotten, however, that ingestion of sodium bicarbonate in rather large doses impedes chloride elimination—in fact, promotes retention thereof. The alkalies contribute to the elimination of uric acid by promoting the formation of soluble alkaline urates.

One may prescribe:

℞ Sodii bicarbonatis .... 10 grams (ʒiiss).
Pone in chart. No. i.
Sig.: Dissolve in one liter (quart) of boiled filtered water or spring water. Drink one large, 250 c.c. (8 ounces) tumblerful in the morning on awakening and at night on retiring.

℞ Sodii benzoatis,
Sodii bicarbonatis ....āā 0.3 gram (gr. v).
Ft. cachet. No. i. Da tal. No. L.
Sig.: Four cachets daily (CASTAIGNE).

URIC ACID SOLVENTS.—There is a considerable list of these: Lithium salts, piperazin, lycetol, thyminic acid, etc.

Sodium benzoate and *sodium salicylate* are valuable uric acid solvents, antiseptics and cholagogues, in daily use in doses of 1 to 4 grams (15 to 60 grains) in powders or solutions, preferably in conjunction with sodium bicarbonate.

LITHIUM BENZOATE.—This may be prescribed as follows:

℞ Lithii benzoatis (N. F.) .... 0.5 gram (gr. viiss);
Sodii bicarbonatis .... 0.25 gram (gr. iv).
Ft. cachet. No. i. Da tal. No. L.
Sig.: One cachet in the morning on an empty stomach; another at 5 P.M. with a cupful of milk (CASTAIGNE).

Lithium carbonate or citrate may be similarly prescribed.

PIPERAZIN, or diethylen-diamin $(C_2H_4)_2$ $(NH)_2$, yields a soluble (1:47) urate when brought in contact with uric acid *in vitro*.

℞ Piperazin .... 10 grams (ʒiiss);
Aquæ destillatæ .... 300 c.c. (f℥x).
M. Sig.: One or two tablespoonfuls in a glass of Seltzer water at each meal (CASTAIGNE).

LYCETOL (dimethylpiperazin tartrate):

℞ Lycetol,
Theobrominæ ....āā 0.5 gram (gr. viiss).
Pone in chart. No. i. Da tal. No. xxx.
Sig.: One to three powders daily.

METHENAMIN, or hexamethylentetramin (urotropin), $(CH_2)_6N_4$, is diuretic, uricolytic, and a urinary antiseptic. It is prescribed in powders, tablets, cachets or by intravenous injection.

It is decomposed in the system [acid media] with liberation of formaldehyde, the antiseptic power of which is well known.

(*a*) ℞ Methenaminæ,
Theobrominæ ....āā 0.5 gram (gr. viiss).—M.

(*b*) ℞ Methenaminæ,
Sodii benzoatis ....āā 0.5 gram (gr. viiss).—M.

(*c*) ℞ Methenaminæ,
Lithii benzoatis ....āā 0.25 gram (gr. iv);
Theobrominæ .... 0.5 gram (gr. viiss).—M.

The above combinations may be given in powders or cachets—one to three a day.

(*d*) A solution of methenamin in water, 0.25 gram to 1 c.c., prepared in the cold and then tyndallized, may be used for intravenous injections (Loeper and Grosdidier). The dose is 1 to 4 c.c. (16 to 64 minims) a day.

Such injections have been employed for resolvent, diuretic and sedative purposes in infectious disorders (typhoid fever, pneumonia, hepaticorenal infections, etc.).

THYMINIC ACID, or solurol, $C_{30}H_{46}N_4O_{15}.2P_2O_5$, is the strongest solvent of uric acid, of which it dissolves three times its weight at 37° C.

It is used in tablets of 0.5 gram (7½ grains) each; one to two tablets a day.

CINCHOPHEN, phenylcinchoninic acid, or phenyl-quinolin-carboxylic acid (atophan), $C_9H_5N.C_6H_5.COOH$, is used in tablets or powders of 0.5 gram (7½ grains), of which 6 to 8 are taken daily in acute cases (*acute gout, acute rheumatism*) and 1 or 2 in chronic cases (*sciatica, hemicrania, gout in the intervals*).

[*Cinchophenum,* U. S. P., 0.5 gram (8 grains).]

With nearly all of the above agents the increased excretion of uric acid seems to be due to a twofold action (true *uricolytic* action, through formation of soluble urates, and *diuretic* action, by stimulation of renal epithelium), so that they might almost as properly be described in the section on diuretics as in that on the uric acid solvents. It is also this stimulating action on the renal epithelium which introduces an element of risk in their unduly protracted or too frequently repeated use: Exaggerated stimulation of any organ brings on degeneration and fibrosis therein.

Aside from this, they nearly all act as *antiseptics* and from this circumstance find additional indications in *infections of the urinary tract* and *liver*. Methenamin is a standard agent in this connection.

They lend themselves to a great variety of combinations, generally calculated to associate the *diuretic, uricolytic* and *antiseptic effects*. Benzoic and salicylic acid, the salts of lithium, methenamin (urotropin), the quinolin derivatives and theobromine are the commonest ingredients of these combinations, many of which are unofficial.

THEOBROMOSE, among others, is described as a theobrominate of lithium. It is mainly a diuretic. It is soluble in water. A solution con-

taining 0.15 gram (2½ grains) of the drug to the tablespoonful is used; 3 or 4 tablespoonfuls daily. Tablets containing 0.25 gram (4 grains) are also available, 3 to 6 being taken a day.

URASEPTIN is a soluble granular preparation containing piperazin, methenamin, and the benzoates of sodium and lithium. The dose is 0.5 gram (7½ grains). Four such doses are generally taken daily, between meals.

FIBROLYTIC AGENTS.

THIOSINAMIN.

This is chemically allyl-thiol urea or allyl-sulphocarbamid. It is almost insoluble in water, but yields with sodium salicylate a rather soluble (15 per cent.) double salt, commercially known as *fibrolysin;* the same applies to antipyrin, which yields with it a more soluble and more stable mixture.

Thiosinamin has been claimed to antagonize fibrosis and widely recommended to promote absorption of fibrotic processes in general. The clinical results, however, have not been in the least convincing.

Following are two formulas for intramuscular injections:

℞ Thiosinamin	15 grams	(℥ss);
Antipyrinæ	7.5 grams	(ʒij);
Aquæ destillatæ	100 c.c.	(f℥xxvij).—M.

(LERMOYEZ and MAHU.)

℞ Thiosinamin	10 grams	(ʒiiss);
Glycerini	8 c.c.	(fʒij);
Sodii salicylatis	20 grams	(ʒv);
Aquæ destillatæ q. s. ad	100 c.c.	(f℥xxvij).—M.

(MULLER.)

One c.c. (16 minims) of the above preparation contains 0.1 gram (1½ grains) of thiosinamin. Intramuscular injections of 1 to 2 c.c. (16 to 32 minims) are given daily or on alternate days for twenty-five to thirty days.

VII

ORGANOTHERAPEUTIC AGENTS.

ENDOCRIN AND EXOCRIN PRODUCTS.

No attempt can be made here to present more than a brief summary of organotherapy (opotherapy). Continuing to follow the original plan of the work, I shall limit consideration of the subject to a short account of the general principles on which such treatment is based and a tabular presentation of the indications for the preparations most commonly used.

By opotherapy (ὀπός, juice, tissue humor; θεραπεία, cure) is meant treatment by means of extracts of the glands of animals, and in fact, by the actual substance of these glands.

As old as medicine itself, practiced empirically in all times, and foreseen by Claude Bernard, opotherapy was afforded its scientific foundation and introduced into medical practice by Brown-Séquard. He based the procedure on the concept of the internal secretions—a concept singularly broadened since that time, and which may be summarized thus: The internal secretions consist "of the aggregate of the products secreted by cells, generally of epithelial type, grouped around the vessels of the different organs, such products being poured directly into the circulating blood by the veins, without the intervention of any excretory duct," and if, with Professor Renault, one considers all cellular tissues as forming an immense internally secreting gland, an almost complete recasting of the humoral doctrine is seen to be the necessary result.

Physiologic experimentation (removal, transplantation, and injection), as well as clinical observation and therapeutic experimentation show:

1. That certain morbid manifestations are dependent upon disturbances in the internal secretions of certain definite organs (adrenals in Addison's disease, thyroid gland in myxedema, pancreas in pancreatic diabetes, etc.).

2. That these manifestations can be antagonized, often with success, by the administration of extracts obtained from the corresponding organ of a healthy animal.

ENDOCRIN GLANDS.

The products secreted by them, their functional correlations, and the diseases or disturbances which result from suppression or modifications of these organs and their secretions (Gley).

	ORGANS.	PRODUCTS SECRETED.	PHYSIOLOGIC ROLE of the products secreted.	RELATIONSHIPS between	DISEASES.
I.—Metabolic Glands (Concerned with Changes in Substances).					
Glands which elaborate or transform: 1. *Substances concerned with nutrition.*	**Glands of the intestinal mucosa.**	Fats.	Energy expenditure.	*Intestines and tissues.*	—
	Liver.	Glucose.	Energy expenditure.	*Liver and muscles.*	**Diabetes through hepatic hypersecretion of sugar.**
	Pancreas.	Ferment (?) concerned in glycogenesis or glycolysis.	Formation of glycogen or destruction of sugar.	*Pancreas and liver.*	**Diabetes through suppression of the pancreas.**
2. *Waste matters.*	**Liver.**	Urea. Phenylsulphates.	Transformation of toxic into non-toxic substances (antitoxic function of the liver).	*Liver and kidneys.*	—
	Parathyroids.	—	Antitoxic function (?).	*Thyroid and parathyroids.*	**Tetany due to suppression of function.**
3. *Substances subserving morphogenesis.*	**Interstitial glands of testicle and corpus luteum.**	—	Development of the genital tract and accessory genital glands. Development of the bony skeleton.	*Interstitial gland or corpus luteum and accessory genital glands. Interstitial gland and osseous tissue.*	**Infantilism of testicular origin.**
	Thyroid.	—	Development of the bony skeleton. Development of the nervous system. Development of the germinal gland.	*Thyroid and osseous tissue. Thyroid and brain. Thyroid and testicles or ovaries.*	**Arrested development. Cretinism. Myxedematous states.**
	Pituitary.	—	Development of the bony skeleton.	*Pituitary and osseous tissue.*	**Acromegaly.**

II.—Glands Concerned in the Maintenance of Internal Media.					
	Liver.	Antithrombin.	Coagulability of blood.	*Liver and blood.*	**Hemophilia from excess of antithrombin.**
—	**Choroid plexuses.**	Cerebrospinal fluid.	Known mechanical function. Eliminatory function (?).	—	—
III.—Glands Regulating and Exciting Functions.					
	Glands of the duodenojejunal mucosa.	Secretin.	Pancreatic secretion.	*Stomach, duodenum and pancreas.*	—
	Adrenals.	Adrenalin.	?	?	**Addison's disease. Adrenal insufficiency (?).**
—	**Myometrial gland or placenta or fetus (?).**	Galactagogue substance.	Milk secretion.	*Uterus, placenta or fetal organs and mammæ.*	—
	Thyroid.	Substance exciting katabolism.	Nitrogenous and respiratory interchanges.	*Thyroid and tissues in general.*	**Slowing of metabolism due to deficiency of thyroid secretion.**
IV.—Organs Subserving Nutrition or Morphogenesis. *Organs non-glandular, but assuming the rôle of endocrin glands.*					
	Adipose tissue.	Fat.	Energy expenditure.	—	—
—	**Spleen.**	Trypsinogenin.	Activation of trypsin.	*Spleen and pancreas.*	—
	Thymus.	—	Development of bony skeleton.	*Thymus and osseous tissue.*	—

In this connection, one must always turn back to the crucial experiment of Schiff demonstrating that, to cause an animal to recover from the effects following removal of the thyroid, it is sufficient to transplant a normal thyroid into the peritoneum or to administer the active principles of this gland.

Such was the original scientific foundation of organotherapy.

Since then, the practical concept of organotherapy has extended much beyond the foregoing limits. Thus, one now hears sometimes the expression "gastric opotherapy," meaning the administration of gastric juice, a purely external secretion.

Through a form of linguistic distortion, the term opotherapy is tending to assume the meaning of treatment by means of animal tissues or their secretions.

To obtain a comprehensive view of the question of opotherapy, to appreciate its complexity and foresee its future development, it would be appropriate to refer to the report of Gley to the International Medical Congress held in London in 1913. The tabular classification proposed by this author, which is reproduced herewith (page 234), in itself affords a sufficiently comprehensive collective summary of the subject.

* * *

Sicard has written an excellent condensation of the above-mentioned report:

"At all events, experimentation has shown the all-embracing reality of these internal secretions. In particular, it has been found that they possess a rôle of producing remote effects, carried out rather through the intermediation of the blood than through that of the nervous system. It became necessary to coin a name for them, and Starling, in a general fashion, proposed that of "hormones" (from ὁρμάω, I arouse). Among the **hormones,** two in particular are known for THEIR DIRECT EFFECTS, *viz.,* the **hormone secretin** (duodenal mucosa), which induces pancreatic hypersecretion, and the **adrenalinic hormone** (suprarenal capsule), which maintain the vascular tonus.

"Other hormones exert less distinct actions—actions of a less specific character. They do, indeed, produce remote effects, but they possess more especially a morphogenetic rôle, as Gley points out. These are **harmosones** (from ἁρμόσσω, I rule, I direct). The harmosones direct at a distance the tissues subserving the growth of the individual, in particular the bony skeleton (thyroid body, testicle, pituitary).

"It is understood that the remote actions of the hormones or of the harmosones may be exerted, not on miscellaneous tissues such as the nails, hairs, cartilaginous, bony or vascular tissue, but on tissues definitely of the endocrin glandular type, constituting thus the group of the *interglandular functional hormonic relationships.*

"The secretory product of a given gland is necessary to insure the normal functioning of some other gland. One may thus conceive of systems with two or three components, thyro-testicular, thyro-pituito-testicular, etc. It is likely that under normal conditions there exists a general regulating endocrin mechanism, through the mutual interaction of different hormones. *This represents the olo-glandular endocrin balance.*

"There are, however, other considerations of great interest which may be invoked in the study of imbalance or loss of harmony of this olo-glandular endocrin system. How, indeed, can such a loss of harmony be brought about?

"(a) *Either by abrupt and complete elimination of one gland.* This is one form of imbalance. Under these circumstances there can be no question of a vitiation of secretion, but merely of an absolute lack of secretion.

"(b) *Or by an excess or lack of a qualitatively normal secretion* (quantitative vitiation through excess or lack). One may conceive of the actual occurrence of this "deficiency" type, in spite of the possibility obtaining in the case of most of the endocrin glands of carrying on their useful rôle with a minimal amount of glandular tissue.

"(c) *Or by vitiated secretion, and by excess or lack of this vitiated secretion* (the vitiation being quantitative and qualitative, progressive, or stationary after a certain period of progression).

"It is to these vitiations of secretion that one might apply the general term of *diaphtherones* (from διαφθείρω, to vitiate), in contrast to the *hormones* or the *harmosones,* or normal internal secretions.

"The reason I call your especial attention to these quantitative and qualitative secretory disturbances, which may or may not be interconnected (Roussy), is that they appear to me to play an important rôle in the pathogenetic explanation of certain clinical syndromes, uni- or polyglandular and of a complex nature (Claude and Gougerot, Rénon, Laignel-Lavastine, Léopold-Lévi, Martinet, etc.)."

* * *

For a long time the manner of administration consisted exclusively of the hypodermic injection of gland extracts, it being supposed that

these extracts must be deleteriously affected by the digestive fluids. Numerous experiments have shown, however, that upon ingestion these products appear to yield effects identical or at least comparable with those obtained by injection. Accordingly, while retaining the practice of injection for the cases in which a more powerful and rapid action is desired, one may in the majority of instances adopt the oral route, which is naturally simpler and less burdensome.

For oral administration, there are employed either the partial extracts—actual or supposed isolated active principles of the glands (though, in truth, actually active partial extracts seem to have been isolated only in the case of adrenalin from the adrenals and thyroxin from the thyroid); or the extracts of the entire glands (fresh glands, glycerin extracts, and in particular dried extracts), which lend themselves to many different modes of preparation, *e.g.*, tablets, capsules, pills, powders, cachets, globules, granular products, elixirs, etc.

The choice in the individual case depends upon the dose to be given, whether the product has an unpleasant taste or not, whether it will keep, etc.

Consideration of the organotherapeutic products herein will be limited to the accompanying tables, showing the chief products with their pharmaceutic forms, indications and dosage.

TABLE SHOWING THE MAIN FORMS OF ORGANOTHERAPEUTIC MEDICATION.

	PREPARATIONS.	DOSES.	INDICATIONS.
Thyroid Opotherapy. *Contraindications:* Tachycardia. Glycosuria. Emaciation. Diarrhea. Vomiting.	**Fresh sheep gland** in bouillon or on bread, or in cachets with salol (*to prevent fermentation*). **Desiccated gland powder** (tablets, capsules, pills, troches, or cachets). **Thyroidin or Iodothyrin of Baumann.** **Thyroxin.**	0.5 gram (initial dose) to 1.5 grams (maximum). 0.1 to 0.4 gram a day. 0.25 to 5 grams in the adult. 0.1 to 1 gram in children. (0.001 gram = 1 gram of desiccated gland).	*Myxedema, infantile, endemic, spontaneous in the adult or post-operative.* *Goiters, non-toxic.* *Attenuated thyroid insufficiency: Arrested development, adenoid vegetations, delayed puberty, nocturnal enuresis, delayed consolidation of fractures, acromegaly, obesity, gigantism, certain forms of chronic rheumatism, etc.* *Psoriasis (?) Scleroderma (?).*
Adrenal Opotherapy.	**Adrenalin (epinephrin).** **Fresh sheep adrenals.** **Desiccated gland powder, tablets or capsules.** **Glycerin extract,** for hypodermic injection.	0.001-0.003 gram. ½ to 1 gland (0.5 to 3 grams). 0.12 to 0.6 gram 2 c.c.	*Addison's disease.* *Hemorrhage (pulmonary, gastro-intestinal, nasal, dental, etc.).* *Low blood-pressure (cardiovascular asthenia, operative shock).* *Cancerous ulcerations.* *Hyperemic affections (ocular, nasal, tonsillar, pharyngeal), asthma, etc.* *Osteomalacia.*
Pituitary Opotherapy.	**Extract of whole organ.** **Pituitarium,** U. S. P. (posterior lobe). **Liquor pituitarii,** U. S. P. (posterior lobe).	0.25 to 1 gram 0.003 to 0.03 gram. 0.2 to 1 c.c.	*Acromegaly.* *Gigantism.* *Paralysis agitans.* *Graves's disease.* *Low blood-pressure due to cardiac poisoning in infections (diphtheria, typhoid, pneumonia, tuberculosis, influenza) or to chronic myocarditis (mitral disorders).* *Obstetrics.* *Shock and collapse.*

TABLE SHOWING THE MAIN FORMS OF ORGANO-THERAPEUTIC MEDICATION (*continued*).

	PREPARATIONS.	DOSES.	INDICATIONS.
Ovarian Opotherapy.	**Fresh ovaries of cow or heifer.**	5 to 10 grams	*Menopause, natural or operative (oöphorectomy).*
	Desiccated gland powder, tablets, capsules or pills.	0.2 to 0.6 gram	*Dysmenorrhea of chlorosis.*
	Corpus luteum powder.	0.1 gram	*Dystrophic states from ovarian insufficiency (infantilism, pseudo-myxedema).*
	Ovarian residue (minus corpus luteum).	0.12 gram	
	Injectable ovarian extract.	2 to 3 c.c.	*Hot flushes, suffocative sensations.*
	Ovarian lipoid, injectable.		
Testicular Opotherapy.	**Fresh gland** of **bull** or ram.	5 to 10 grams.	*Debility in general.*
	Desiccated gland tablets.	1.5 to 3 grams	*Senile debility.*
	Injectable glycerin or lipoid extract.	3 c.c.	*Impotence.*
Pancreatic Opotherapy.	**Fresh pancreas of sheep or calf.**	30 grams.	*Hypopepsia. Gastro-intestinal dyspepsia.*
	Desiccated gland in tablets or enteric-coated capsules.	2 to 3 grams.	*Pancreatic insufficiency. Diabetes with poor nutrition.*
	Pancreatin (soluble ferment extract), in powder, capsules, or enteric-coated pills.	0.5 to 1 gram.	*Diabetes from hepatic over-activity.*
	Insulin.		*Severe diabetes.*
Hepatic Opotherapy.	**Fresh liver in bouil**lon or maceration as enema.	100 to 200 grams.	*Atrophic cirrhosis (ascites, hemorrhage).*
	Dry extract in a cold drink, chocolate, cachets, etc.	10 to 15 grams. 2 to 4 teaspoonfuls.	*Gout; diabetes from hepatic inactivity.*
	Glycerin extract in a cold drink (tea, milk, white wine, etc.).	2 to 4 teaspoonfuls.	*Gastro-intestinal indigestion with hepatic insufficiency.*
	Injectable hepatic extract.	2 to 3 c.c.	
Bone-Marrow Opotherapy.	**Fresh calves' marrow** in a broth.	50 to 100 grams.	*Splenic leukemia. Anemia of Hodgkin's disease.*
	Dry extract in powder or tablets.	0.5 to 1 gram.	*Pernicious anemia with myeloid reaction.*
	Glycerin liquid extract.	2 to 3 tablespoonfuls.	*Contraindicated in aplastic anemias.*

TABLE SHOWING THE MAIN FORMS OF ORGANO-THERAPEUTIC MEDICATION (*continued*).

	PREPARATIONS.	DOSES.	INDICATIONS.
Cardiac Opotherapy. (See also *Diseases of the Respiratory Tract.*)	**Powdered heart.** Dry extract concentrated *in vacuo*. **Heart peptone.** Dry extract concentrated *in vacuo* and peptonized. **Elixir of heart peptone.**	1 to 3 teaspoonfuls. 1 to 3 dessert-spoonfuls.	*Cardiac insufficiency.* *Chronic myocarditis.* *Hyposphyxia.*
	External Secretions.		
Diastase.	**Powder** in tablets or cachets.	0.5 to 1 gram.	*Carbohydrate indigestion (starches, rice, barley, potato, dried vegetables, pastes, etc.).*
Pepsin.	**Elixir.** Tablets. Cachets.	Do.	*Dyspepsia in general.* *Anorexia.* *Gastric intolerance.*
Trypsin.	Do.	Do.	*Intestinal indigestion.* *Incomplete digestion of proteins and milk.*
Pancreatin (See above, *Pancreatic Opotherapy.*)			*Pancreatic insufficiency.*
Enterokinase.	Do.	Do.	*Pancreatic insufficiency.* *Intestinal indigestion.*
Gastric juice.	Hog's or dog's gastric juice, taken just before meals in malt extract, beer, tea, lemonade, etc. Avoid milk, which the gastric juice coagulates, as well as alkaline beverages, which neutralize it.	1 to 3 table-spoonfuls.	*Dyspepsia with hypo- or achlorhydria, including the pretuberculous variety.* *Gastro-enteritis.* *Obstinate diarrhea.*
Bile.	**Whole dried extract of oxgall,** in tablets or pills, during or after meals. **Extractum fellis bovis,** U. S. P. (1 gram = alcohol-soluble constituents of 8 grams of oxgall).	1 to 2 grams. 0.4 gram.	*Acholia or hypocholia.* *Intestinal atony, constipation.* *Cholelithiasis, hepatic colic.* *Mucous enterocolitis.* *Gastro-intestinal indigestion with flatulence and clayey stools.*

DRUGS ACTING SELECTIVELY ON INFECTIOUS AND PARASITIC DISORDERS.

I. SPECIFIC DRUGS.

CLASSIFICATION OF DRUGS.—The drugs used in combatting infection act either in a selective and specific manner on some definite infectious agency (*specific anti-infectious agents*) or in a general way on infection, whatever be its nature, by enhancing the natural processes of reaction against infection (*non-specific anti-infectious agents*).

This convenient classification is far from being scientifically accurate. A discussion of its justification from the practical standpoint and of the amendments which it would actually require would take up too much space. Such being the case, let us accept it as a convenient mnemonic device, sufficient in its approximation to the truth to be of practical use.

DRUGS ACTING SELECTIVELY ON INFECTIOUS CONDITIONS.

I. **Specific.**

Serum therapy.

Vaccine therapy.

Bacteriotherapy: Lactic ferments.

Chemotherapy:
- *Antisyphilitic:* Mercury, arsenic.
- *Antimalarial:* Quinine, arsenic.
- *Antirheumatic:* Salicylates.
- *Antidysenteric:* Emetine.
- *Anthelminthic:* Male fern.

II. **Non-Specific.**

Antiseptics: Type drug, methenamin.

Antipyretics: Type drug, antipyrin (see *Nervous Depressants*).

Protein therapy: Type drugs, collargol, peptone.

SERUM THERAPY.

(Written in collaboration with Dr. A. LUTIER.)

Many more or less comprehensive definitions of serum therapy have been proposed. It would appear sufficient, adhering to the obvious meanings of the component words, serum and therapy, to define it as "the aggregate of curative or preventive procedures which secures its active factors from serums, the latter term designating the clear fluid which separates from the clot when the blood of an animal is allowed to stand."

This definition would seem to include all there is of true serum therapy; it excludes, of course, the "artificial serums."

No single volume, however large, could suffice to present with all due detail the complex and many-sided subject of serum therapy, to which entire libraries have been devoted. In conformity with the essentially practical nature of this work, and its embodied aim of immediate utility, consideration of the subject will be limited to a clear and succinct description of the facts necessary and sufficient for the ordinary application of serum therapy.

Much additional information on special divisions of serum therapy will be found in the various sections devoted to the diseases and syndromes amenable thereto (infectious diseases: diphtheria, cerebrospinal meningitis, tetanus, dysentery, etc.; exophthalmic goiter, anemias, asthma, etc.).

* * *

The form of serum therapy most generally practiced—that which brought this therapeutic method a triumphant success, which the lapse of years has but served to confirm—is **specific antimicrobic therapy**; the original and classical instance of this is represented by **antidiphtheritic serum.**

The field of serum therapy has, however, expanded in several directions. The observation that specific serums could exert a favorable effect on different infectious processes (*e.g.*, the favorable effect of diphtheria antitoxin in non-diphtheritic sore throats) and that even normal horse serum exerted a favorable effect in many infections led to various attempts, more or less successful, at **non-specific serum therapy,** the most widespread form of which is the now common use of **normal horse serum.**

In another direction, careful study of the immunity reactions broadened our conception of this process and showed that the re-

active formation of specific antibodies is a very widely distributed phenomenon, and one which can be evoked by the introduction of some substance foreign to the body into the blood. This proved the starting-point of many kinds of **non-microbic specific serum therapy,** the most typical of which is **antivenomous serum** (antivenene), and of the attempts at treatment of infections by the production of hemoclastic shock.

Finally, the concept of reactive blood adaptation, further broadened, was extended to include pathogenic processes induced by functional and organic disorders of internal organs, and led to interesting diagnostic and therapeutic applications and, in particular, to various forms of **organic, para-opotherapeutic specific serum therapy,** of which the two instances now most widely known are **hemato-ethyroidin** and **antinephritic serum.**

* * *

SPECIFIC ANTIMICROBIC SERUM THERAPY, at the present time still the most important variety of serum therapy in practice, is based on the two following experimental propositions:

1. It is generally possible by means of injections of gradually increasing, virulent doses of pathogenic bacterial agents (bacteria or their toxins, or both), to immunize an animal against the pathogenic agent used. The animal is ultimately completely immunized, *i.e.,* is capable of withstanding without an appreciable reaction supralethal doses of the agent in question.

2. The serum of an animal thus immunized, injected into another animal, is capable of conferring upon the serum of the latter its immunizing properties, either preventively or curatively according to the case. *Antidiphtheritic serum* and *antimeningococcic serum* are, up to this time, the most typical representatives of these specifically curative serums. They have, indeed, led us to expect too much, through processes of hasty and unwarranted generalization. The results already obtained are in themselves sufficiently impressive to preclude any need of faulty deductions therefrom.

But, as has already been mentioned, much experimentation and observation has shown that, apart from the *actually specific action* exerted by these serums, they bring about in addition in an extra-specific manner reactive phenomena, sometimes of a beneficial character, in respect of many infections to which they are not directly related. This extra-specific anti-infectious serum therapy, evoked through stimulation of organic reactions against infection, is a most interesting procedure.

SERUM THERAPY.

SERUMS.	NATURE, SOURCE, MANNER OF PREPARATION.	CUSTOMARY DOSE.	MODES OF ADMINISTRATION.	INDICATIONS.	PROPHYLACTIC USE.	UNTOWARD RESULTS. REMARKS.
Anti-diphtheritic.	Antitoxic serum from the jugular blood of horses immunized to the Klebs-Loeffler bacillus by the injection of increasing doses of diphtheria toxin with addition of Gram's solution.	*Adults:* 5000 to 10,000 and even 15,000 units. *Children:* Below one year: 3000 to 5000 units. Above one year: 5000 to 7500 units.	1. *Daily hypodermic injections* until fever subsides and membranes are detached. 2. *A single sufficient dose intravenously.* 3. *Powdered desiccated serum* insufflated into the nasal cavities and throat, or a *serocollutory* painted or sprayed in the nasal cavities and throat. 4. *Troches* or *tablets* prepared with the *dried serum;* to be allowed to dissolve in the mouth at the rate of 1 tablet hourly.	**Diphtheria,** wherever located.	250 to 1250 units (according to age), given hypodermically. Immunity lasts but 3 or 4 weeks at the most.	The serum, when injected in a patient with lung tuberculosis, sometimes "whips up" the tuberculous process.
Antimeningococcic.	Antitoxic serum from horses immunized by intravenous injection of increasing doses of a living culture of meningococci.	*Adults:* 40 to 80 c.c. *Children:* Below 2 years: 15 to 30 c.c. Above 2 years: 20 to 40 c.c.	1. *Daily intraspinal injections* for 3 or 4 days, until the meningococci have disappeared and the temperature subsided, with improvement of the symptoms in general. (Previously withdraw an equal amount of cerebrospinal fluid. After each injection elevate the pelvis by raising the foot of the bed.)	**Cerebrospinal meningitis confirmed** by lumbar puncture. Hypodermic injections are for the extrameningeal meningococcic manifestations; intravenous injections, in the protracted forms.	—	After a number of intraspinal injections, a serum reaction may develop (rigidity of neck, Kernig's sign, convulsions, etc.; serum meningitis). The injections should be discontinued. A relapse is differentiated from such a serum reaction by the presence of meningococci in the cerebrospinal fluid. In the event of a

			2. Hypodermic injections. 3. Intraventricular injections.			relapse, if the injections have already been stopped for several days, fatal anaphylaxis is to be feared and Besredka's method should be employed (hypodermic injection of 2 to 5 c.c. of serum 15 hours before the intraspinal injection).
Antiparameningococcic.	Obtained from horses immunized against parameningococci.	Do.	Do.	**Parameningococcic cerebrospinal meningitis** confirmed by lumbar puncture. This serum may be used when the preceding variety has not given distinct results after 3 or 4 days' treatment.	—	Do.
Polyvalent antimeningococcic.	Obtained from horses immunized both against the meningococci and the parameningococci.	Do.	Do.	**Cerebrospinal meningitis** in cases in which a precise bacteriologic diagnosis cannot be made or **remains doubtful.**	—	Do.
Antipneumococcic.	Serum from horses treated so as to withstand increasing doses of pneumococcus cultures.	20 to 100 c.c.	Daily hypodermic injections until the temperature subsides and there is general improvement. [Intravenous injections every 6 to 24 hours may be given instead.]	**Pneumonia.** Respiratory complications of influenza; in such cases antistreptococcic serum may be combined with it.	—	Results not yet well established. Serum reactions are particularly frequent and pronounced.

SERUM THERAPY (*continued*).

SERUMS.	NATURE, SOURCE, MANNER OF PREPARATION.	CUSTOMARY DOSE.	MODES OF ADMINISTRATION.	INDICATIONS.	PROPHYLACTIC USE.	UNTOWARD RESULTS. REMARKS.
Anti-streptococcic (polyvalent). **Anti-pyogenic (polyvalent).** (Strepto-, staphylococcic, colon bacillus, pyocyaneus, etc.).	Serum of horses immunized by intravenous injection of cultures of 10 varieties of streptococci isolated from various human streptococcic disorders (scarlet fever, erysipelas, puerperal sepsis, phlegmon, septicemia, etc.).	Not well established. About 20 c.c. In severe cases: 50 to 100 c.c. a day.	Daily hypodermic injections until improvement occurs (even twice daily in grave cases).	The principal indications are **erysipelas** and **puerperal sepsis**, wounds, phlegmons, and abscesses. Use in **scarlet fever** under discussion. Also used in the respiratory complications of **influenza**, in conjunction with antipneumococcic serum.	—	Results uncertain.
Anti-tetanic.	Serum of horses immunized by inoculation of increasing doses of tetanus toxin, pure or heated to 65-70° C. or with addition of Gram's solution.	10,000 to 20,000 units or more, for curative purposes.	For curative purposes hypodermic or intravenous injections are given, or better, intraspinal injections. In the latter procedure an equal quantity of cerebrospinal fluid is withdrawn; the pelvis should then be elevated by raising the foot of the bed.	*Especially for preventive purposes,* in contused wounds soiled with earth, straw, manure, etc. In these cases it is necessary to reinject a dose every 4 or 5 days until suppuration ceases and healing occurs. Where débridement of a wound is required, a missile is to be removed, or an operation that might set free embedded tetanus spores is necessary, another injection of antitoxin should precede the intervention.	Action chiefly prophylactic. 1500 to 2500 units injected hypodermically.	**Established tetanus.** The serum should be injected for curative purposes in grave cases of tetanus, but the therapeutic result is very uncertain. The customary measures for the treatment of tetanus should be used at the same time.

Anti-dysenteric.	Serum of horses immunized by weekly ascending inoculations of alternate doses of living bacilli and of dysentery toxin (Shiga bacillus).	20 to 100 c.c. according to severity and obstinacy of the condition.	Daily hypodermic injections repeated and graded according to effects and tolerance.	**Bacillary dysentery** of temperate climates.	Prophylactic action as well as curative: 5 c.c. injected hypodermically. Duration of the immunity: Only 15 to 20 days.	Ineffective in the amebic dysentery of tropical countries.
Anti-typhoid.	Serum of horses immunized by intravenous inoculation of filtered cultures of typhoid bacilli in ascending doses.	5 to 15 c.c.	Hypodermic injections. Typically: Three injections at intervals of 2 or 3 days; 5 c.c. to begin with, then 10, then 15 c.c. Sometimes a fourth injection is required.	**Typhoid fever.** In the paratyphoid fevers, the antityphoid serum may likewise act favorably, but this is not constant.	—	Early injections, given before the 11th day of the disease, bring about improvement in the general condition, lower the temperature, and shorten the disease.
Anti-cholera.	Antitoxic serum obtained from the jugular blood of horses immunized against the cholera bacillus by intravenous injection of increasing doses of cholera toxin.	50 to 100 and even 150 c.c.	Serum to be mixed with 500 c.c. of normal salt solution. Daily hypodermic injections.	**Asiatic cholera confirmed** bacteriologically (presence of comma bacilli in the stools).	Prophylactic action as well as curative. Immunity only of short duration.	Results uncertain.
Anti-plague.	Serum of horses immunized by intravenous inoculations of cultures, at first killed and filtered, later living.	Massive and repeated doses. 100 to 200 and even 300 c.c. (for curative purposes).	1. Daily hypodermic injections, or even twice daily, in descending doses. The longer the disease has been present, the higher should be the initial dose. 2. In pneumonic plague: Intravenous injection.	**Plague.**	Prophylactic action certain, but the immunity only lasts about 10 days. The hypodermic injections (10 to 15 c.c.) must therefore be repeated.	—

SERUM THERAPY (*continued*).

SERUMS.	NATURE, SOURCE, MANNER OF PREPARATION.	CUSTOMARY DOSE.	MODES OF ADMINISTRATION.	INDICATIONS.	PROPHYLACTIC USE.	UNTOWARD RESULTS. REMARKS.
Anti-tuberculous.	(See *Tuberculosis.*)	—	—	—	—	—
Normal horse serum.	Normal horse serum collected aseptically and used as such or in the form of a dry extract (obtained *in vacuo*).	Liquid: 10 to 30 c.c. a day. Dry extract: 8 to 10 tablets.	Tablets, by mouth, before the meals. Serum as such or in powder: By mouth, before meals. By enema. Applied locally. Hypodermic injections in grave cases.	*Hemostatic:* **Hemorrhage, hemophilia, purpura.** *Stimulant to phagocytosis.* *Sluggish wounds* (as a dressing).	—	—
Serum of bled horses. (Hematopoietic serum).	Horse serum obtained from an animal frequently bled, each bleeding being carried out a time when the horse is in the stage of active blood regeneration. Serum sterilized by tyndallization.	Liquid serum: 10 to 20 c.c. Tablets: 6 to 8 a day.	Liquid serum (in ampules): Hypodermic injection. Enema. Ingestion. Local application. Dried serum (tablets) by the mouth.	**Hemophilia. Infectious diseases. Atonic wounds.** Anemias. Internal or external hemorrhage.	—	—
Homo-serotherapy. (Convalescent serum).	Serum of individuals convalescent from some infectious disease (influenza, pneumonia, typhoid fever, scarlet fever, etc.).	Variable.	Hypodermic injections.	**Infectious disease from which the convalescent donor has been suffering.**	—	A form of serum treatment still under investigation; results in doubt.
Autoserum, hematic, pleural or ascitic.	Pleural or ascitic fluid, withdrawn by aseptic puncture and at once reinjected, or blood serum, aseptically prepared.	1 to 10 c.c.	Immediate hypodermic reinjection of the fluid withdrawn by puncture.	**Pleurisy,** subacute. **Ascites. Neoplasms** (?).	—	Results uncertain. Possible local gangrene.

Anti-nephritic.	Serum from the renal vein of a goat.	10 to 20 c.c. on alternate days for 6 days in acute cases; 10 c.c. every 6 or 8 days in chronic cases.	Hypodermic injections.	**Uremia** from abrupt suppression of the renal functions (scarlet fever, pneumonia). Acute uremia in the course of chronic nephritis. **Acute nephritis.** **Cardiac kidney.** **Eclampsia** and the albuminuria of pregnancy.	—	Teissier and Thévenot, from whom the preceding data have been obtained, deem the "injection of renal serum a therapeutic measure which is generally beneficial and is devoid of risk."
Anti-gangrenous.	Antitoxic serum of horses immunized against the septic vibrio, *B. perfringens*, and *B. bellonensis*.	20 to 100 c.c.	Hypodermic and intravenous injections, repeated for several days.	Gas gangrene. (The injection should be administered as early as possible.)	—	—
Hemato-ethyroidin (for exophthalmic goiter).	Serum of thyroidectomized animals.	2 teaspoonfuls to 3 tablespoonfuls a day.	By mouth; to be taken in water, during or between meals.	Hyperthyroidism. Exophthalmic goiter.	—	—
Anti-venomous.	Serum of horses inoculated with increasing doses of cobra venom, attenuated by hypochlorite of lime.	Adults: 20 c.c. in cases of bites by European (or American) snakes; 40 c.c. in bites by dangerous ophidian snakes (cobra, etc.). *Children:* 10 c.c.	Early hypodermic injections.	Curative if given early, in any kind of snake-bite. Rather unreliable, however, in viper bites.	—	—

TECHNIC OF SERUM THERAPY IN GENERAL.

Instrumentation.—A glass syringe of 20 c.c. capacity and a needle of rather large caliber are used, both sterilized by boiling for ten minutes. The syringe should be allowed to cool before the serum is drawn into it, in order to avoid coagulation of the serum by heat.

Subcutaneous Injection.—This is the usual mode of administration.

The injection is preferably made in the cellular tissue in one of the hypochondriac regions or flanks; the best point to select is the costal margin, as near as possible to the tenth rib.

The injection should be carried out very slowly.

Intravenous Injection.—In serious cases, especially when treatment is begun late, intravenous injection may be availed of. In general, this route is not, however, to be recommended, as it exposes the patient to anaphylactic shock much more than any of the others.

* * *

Intraspinal injection is the rule in cerebrospinal meningitis and may be indicated in some cases of tetanus.

Intra-articular injection has been practised in gonococcic arthritis.

Local application of serum has been recommended in the treatment of certain suppurating or bleeding wounds (simple horse serum or serum of Leclainche and Vallée).

SERUM DISEASE.—ANAPHYLAXIS.

The introduction of vaccines and of serums into the system not infrequently causes more or less intense reactions.

The vaccines, which constitute virulent material, act merely by bringing on, in as mild a form as possible, the disease against which protection for the individual is desired. But the reactions from vaccines, while severe in some instances, are in general absent or trifling.

As for the reactions which follow injections of serum, a distinction is to be made between those appearing *after an initial serum injection, which are rather late in advent and generally mild,* and those appearing after a second injection, carried out at such a time as to have permitted the first injection to sensitize the subject, *i.e.*, place him *in an anaphylactic state: These anaphylactic mishaps* develop *immediately* after the second injection, and are *sometimes serious* and in exceptional cases fatal.

Anaphylaxis (from the Greek: ἀνα-φυλάξειν = the opposite of "to protect") consists of the hypersensitiveness to certain infections or

intoxications which an individual acquires following such infections or intoxications, after a certain period of incubation. The condition is the exact opposite of immunity.

This phenomenon pertains to a variety of substances, foods or drugs alike, *e.g.*, albumins, milk, serums, organ extracts, etc., in short, to all proteins and to a number of other compounds, substances ordinarily harmless but which, at times, thus behave like violent poisons.

Transfusion of a small amount of citrated blood, intravenous injections of colloidal gold or peptone, anaphylaxis-producing autoserotherapy, auto- or isoplasmotherapy, etc., seem to act by producing a sudden disturbance of humoral equilibrium, the intensity of which is, unfortunately, difficult to predict, and which may pass into a dramatic condition of shock, eclamptic seizures, or coma. These phenomena are allied to anaphylactic shock, which itself consists of a *hemoclastic crisis* or attack, in which *flocculation* of the colloidal complex embodied in the blood serum seems to play a preponderant rôle.

* * *

SERUM DISEASE.

1. Within a short period, or even almost immediately, after the injection, there may be witnessed in some predisposed subjects (*e.g.*, asthmatics): Localized edema at the site of injection, redness, pain, nausea, vomiting, small and frequent pulse, dyspnea, anxiety, myalgias, joint pains, depression, and fever—in short, *serum shock*.

2. After an initial injection of serum, in a subject who has never received serum before, there may be observed rather late, generally about the tenth day after the injection, symptoms generally mild, *viz., urticaria, erythema marginatum, edema, fever, joint and muscle pains, and glandular enlargements.*

3. If the injections of serum are repeated at intervals shorter than ten days, there are observed the same symptoms as follow an initial injection, even oftener than after a single injection.

4. If the injections are repeated at longer intervals, such as fifteen to twenty days, there may then occur an abrupt *anaphylactic shock,* a few minutes after the injection.

Sometimes the manifestations are severe: Intense general discomfort, dyspnea, pallor, frequent, thready and uncountable pulse, vomiting, rise of temperature, cyanosis, sometimes a comatose state. These symptoms are generally transient, disappearing rapidly and without after-effects; in exceptional instances they are followed by death.

In other cases the manifestations are milder: Edema with pseudo-phlegmonous appearance at the site of inoculation, malaise, small pulse, a feeling of oppression, a slight febrile movement, various joint pains and neuralgias, etc. These symptoms soon pass off, with the exception of the local edema, which persists for several days.

This sensitization of the subject may persist for an extremely long period, and such anaphylactic manifestations may be witnessed in subjects who have received an injection of some form of serum several years before.

It is worthy of note, moreover, that this selective sensitiveness has been seen unusually often in subjects who had ingested mare's milk (koumyss) or horse meat. Instances of death in asthmatic subjects have also been recorded.

It is well to recall that large doses of serum do not expose the recipient to anaphylaxis any more than do small doses.

A practical tabular presentation of the various forms of serum therapy so far elaborated and more or less currently used has been given above. In it will be found grouped for practical purposes the nature of each serum, its ordinary dose, its mode of administration, its indications, and, on occasion, certain additional remarks. In one of the columns the prophylactic use of the various serums is considered.

Treatment of Serum Disease. Anti-anaphylactic Measures.—I.—PROPHYLACTIC TREATMENT.—1. *Calcium chloride* may be given as a routine for preventive purposes, after all therapeutic serum injections, in doses of 2 to 4 grams (½ to 1 dram) a day in a solution by the mouth or in an enema; adrenalin or belladonna may also be given by the mouth.

2. According to a communication by Richet, Brodin and Saint-Girons read before the Académie des sciences, the second injection of serum may be rendered harmless by *diluting it with 9 times its volume of physiologic sodium chloride solution.*

In serious cases one might thus make use of the intravenous route of serum administration without fear of anaphylaxis, provided the therapeutic serum be diluted with 9 parts by volume of salt solution and be *injected very slowly.*

It appears as if the sodium chloride diffused through the nerve cell and caused it to become immune to the anaphylactic poison.

3. Lastly, there is available, in *Besredka's method of anti-anaphylactic vaccination* a means, if not of obviating to a certainty the anaphylactic manifestations, at least of lessening their severity.

This procedure consists in giving injections of small amounts of the serum before the massive injection. Its technic varies somewhat according to the route chosen for the reinjection of therapeutic serum.

(*a*) *Hypodermic Reinjection.*—In emergency cases Besredka's procedure is not feasible. Under such conditions the first few cubic centimeters of the serum should be injected very slowly.

In the absence of urgency, the method of successive injections of small doses, recommended by Besredka, should be used.

Either, one may introduce into the patient's rectum 15 to 20 c.c. of the serum, and 6 to 10 hours later carry out the hypodermic injection of the required amount of serum without fear of untoward consequences.

Or, one may begin by injecting slowly 1 c.c. of serum subcutaneously, one hour later inject slowly 2 c.c. of serum subcutaneously, and one hour later inject slowly the entire dose.

(*b*) *Intravenous Reinjection.*—The use of this route may lead to the appearance of very severe anaphylactic manifestations, which occur, moreover, much oftener than after hypodermic reinjections.

To prevent these anaphylactic manifestations, one may:

Either begin with an *intravenous* injection of 0.25 to 1 c.c. of serum, and 15 minutes later carry out slowly the intravenous injection of the total dose.

Or, begin by injecting *subcutaneously,* at intervals of 15 minutes, 1 drop, 5 drops, then 1 c.c. of serum, and 15 minutes later inject the total dose very slowly into the vein.

(*c*) *Intraspinal Reinjection.*—With this form of reinjection anaphylactic reactions are more frequent, and, in particular, much more serious: Intraspinal anaphylaxis is often fatal in man, when it occurs.

To avoid such reactions, one may employ the *method of Darré,* which consists in injecting the serum *very slowly;* the injection can thus be stopped at the first complaint of paresthesia, discomfort or dyspnea. Furthermore, the needle is allowed to remain *in situ* for 5 minutes after completion of the injection. If serious symptoms appear, such as dyspnea, weak pulse or collapse, the largest possible amount of the liquid previously injected can then be withdrawn through the needle.

In addition, caution suggests that one carry out *Besredka's procedure* before the intraspinal reinjection, beginning with an intraspinal injection of 1 c.c. of serum and injecting the total amount two hours later.

If the case is a very urgent one, 1 c.c. of serum may first be injected into a vein and the total amount given intraspinally 15 minutes later.

4. A preliminary intravenous injection of 0.6 gram (10 grains) of sodium carbonate, freshly dissolved in 30 to 40 c.c. (7½ to 10 drams) of sterile distilled water is claimed to be a very effective prophylactic measure (Sicard, Kopaczewski).

II.—CURATIVE TREATMENT.—When anaphylactic manifestations have appeared in a patient in spite of the precautions taken, they should be treated as follows:

If the symptoms are sudden and serious, an intramuscular injection of 4 to 6 c.c. (1 to 1½ fluidrams) of *ether* should immediately be given.

The patient should be purged and kept on a milk diet for a few days.

Calcium chloride should be prescribed in doses of 2 to 4 grams (½ to 1 dram) a day.

Adrenalin should be given by the mouth or by hypodermic injection or, in the serious cases, by intravenous injection, in a dose of 0.00025 gram (1/16 grain).

Local edema should be treated by the application of moist, hot dressings.

Joint and muscle pains should be treated with sodium salicylate or acetylsalicylic acid.

DIGESTIVE ANAPHYLAXIS.—Widal and his co-workers have shown that some instances of urticaria of alimentary origin may be considered as an anaphylactic reaction on the part of the organism. The individual suffering from urticaria of alimentary origin is in a state of anaphylaxis in relation to the proteins of his food, particularly the animal proteins. Ingestion of these proteins causes in him the appearance, in the hours following the meal, of an actual attack similar to anaphylactic shock (Widal's hemoclastic crisis), characterized by leukopenia, low blood-pressure, and disturbances of blood viscosity.

Pagniez and Pasteur Vallery-Radot conceived the idea of applying to the phenomena of digestive anaphylaxis Besredka's method of small, successive anti-anaphylactic doses: They advise the therapeutic use of nitrogenous antigens in small doses, one hour before ingestion of the proteins giving rise to anaphylaxis.

They carry out this treatment by having the sensitized subject ingest one hour before the meal a few grams of the albuminous articles of food to which he is sensitized (fish, egg, etc.).

This treatment is applicable to Quincke's disease (angioneurotic edema) and to some instances of migraine, held to be related to anaphylaxis.

To simplify the treatment, a cachet of 0.5 gram (7½ grains) of peptone can merely be given, one hour before meals.

The effects of this digestive anti-anaphylaxis are not only prophylactic, but also curative: Ingestion of a 0.5 gram cachet of peptone one hour before each meal brought about recovery in a case of Quincke's disease.

To be sure, not all cases of migraine nor all patients with urticaria indiscriminately recover under this treatment. This is not to be wondered at in view of the complex causation of these morbid states. But the treatment referred to is simple and harmless, and only advantage can result from trial of it.

VACCINE THERAPY.

(*Written with the collaboration of Dr. LUTIER.*)

BACTERIAL VACCINES.—The vaccines (from *vacca*, cow, in relation to the antivariolar vaccine obtained from pustules on cows affected with cowpox), even before Pasteur's time, already had to their credit the unquestionable and all-important triumph of preventive inoculation with smallpox (Lady Mary Wortley Montague) and with vaccine from heifers (Jenner's cowpox). Since Jenner's discovery, however, the meaning of the word *vaccine* has been extended; vaccine therapy has taken on renewed activity, preëminently under the influence of the labors of Sir A. E. Wright.

The vaccines now comprise all microbic products introduction of which into the system is capable of inducing an immunity reaction in respect of the germs used. They afford a procedure of active immunization in a definite infectious disease; the attenuated germ of the disease, consisting of a killed culture, freed from its exotoxins, is inoculated and is intended, by its action, rapidly to place the system in a state of defence against the invader.

Many favorable results obtained with vaccine therapy, *e.g.*, in typhoid fever and many local infections, and credited to the specific action of the vaccine, are in reality due only to the general reaction or protein shock which any bacterial protein is capable of bringing about.

Vaccines have been availed of both for the prophylaxis and the treatment of infectious diseases: Preventive vaccination as well as curative vaccine therapy.

I. CURATIVE VACCINE THERAPY.

New attempts at treatment of various infections with bacterial vaccines are constantly being made.

This very general method of treatment, while as yet applied only exceptionally, is undoubtedly destined to play an important part in the treatment of the common infections. To avoid numerous untoward possibilities it is particularly necessary to recall the essential requirements relating to its use and the various facts concerning it now available.

1. *Specific treatment requires a* **specific diagnosis.** This is the first and fundamental proposition in vaccine therapy. A streptococcic pyemia will not be influenced by a staphylococcic vaccine and *vice versa.* The physician intending to make use of vaccine treatment must, therefore, be enough of a bacteriologist to make a correct bacteriologic diagnosis. If the use of an autogenous vaccine is recognized as being necessary, he will even have to be a bacteriologist familiar with the most delicate manipulations of bacteria and have a well-equipped laboratory at his disposal.

2. *Either an* **autogenous vaccine** *or a* **stock** *or* **hetero-vaccine** *may be employed.*—The autogenous vaccine is a personal vaccine, *i.e.,* one prepared with germs isolated from the lesions existing in the patient himself.

Stock vaccines are microbic suspensions prepared *en bloc* from typical, "standardized" cultures of specific germs. They are generally *polyvalent, i.e.,* prepared with several strains of the same germ. They are on the market and can be used as easily as diphtheria antitoxin.

When possible it is preferable to resort to an autogenous vaccine, the activity of which is much more pronounced and constant, but in practice securing such a vaccine brings in certain undoubted difficulties which render it necessarily an exceptional rather than a regular form of treatment.

There are some bacterial vaccines which are so difficult to secure, *e.g.,* those of gonococcus infection and of tuberculosis, that one is almost necessarily compelled to use stock vaccines. As for staphylococcus vaccine, the treatment can be begun with a stock vaccine and continued with autogenous vaccine if the stock preparation fails.

This question of the stock vaccines and autogenous vaccines is related to the much broader and peculiarly difficult question of the classification of groups, genera, species and varieties of animals and plants.

The so-called "specific" immunity, indeed, is not always strictly limited to a single species or genus. Thus, the blood serum of a rabbit immunized with horse's blood will not exclusively cause hemolysis of horse's blood but also, although in a less degree, of ass's and zebra's blood. The blood serum of a rabbit immunized against human blood will in some measure cause hemolysis of the blood of the higher apes. An antiserum for sheep's blood will react more or less with ox's or antelope's blood.

Along the same line of thought, injection of a particular variety of streptococci will immunize the patient, not only against this variety, but also more or less against the entire group of the streptococci. It is precisely this extension of the immunity to species and varieties related to that employed which warrants the use of and accounts for the possible successful results with stock vaccines. If, as happens frequently with polyvalent vaccines, the stock vaccine contains a variety identical with or closely related to the pathogenic germ in question, the therapeutic result will be excellent. If, on the other hand, it does not contain any bacterial component corresponding to the pathogenic species of germ, the result will be practically *nil* and the use of an autogenous vaccine will be necessary.

3. *One should avoid considering vaccine treatment a panacea.*—At one time it was hoped to apply serum therapy to all infections; actually, it has been recognized as being useful only in a small number of diseases in which the microbic toxins dominate the situation and can be neutralized *in vivo* with the antitoxins obtained by animal immunization (diphtheria, tetanus, cerebrospinal meningitis, etc.).

When the dominant pathogenic factor is not the toxin but the invading germ itself, the problem is more complex.

The immunization conferred upon an animal is with difficulty transmissible to the patient. It is under these circumstances that attempts at direct immunization with bacterial vaccines are warranted.

It seems probable that the field of vaccine therapy will be definitely limited, like that of serum therapy, but at the present time its limits cannot be foreseen.

4. *Vaccine treatment alone is not sufficient.*—Specific therapy with vaccines should not exclude the ordinary treatment of disease.

"This treatment cannot authorize the physician to cast aside the remedies which have proven their worth in meeting numerous clinical indications." (Allen.)

5. *Vaccine therapy cannot be availed of in all individuals.*—It is a measure requiring a reaction on the part of the organism. One must

be certain that the organism in which the inoculation is made will be able successfully to go through this reaction.

6. *Vaccine therapy should be used early,* as closely as possible to the incubation period, before the invading germ is disseminated too widely or has developed too much power, and before the individual has exhausted his energies.

7. *Vaccine therapy is appropriate in acute, subacute or chronic cases, but should not be employed in hyperacute* (fulminating) *infections.*—In these cases, indeed, a large amount of endotoxin is set free by the germs which die spontaneously, and it would be illogical to introduce still more of these endotoxins with the vaccine.

WHAT VACCINE SHOULD BE USED?—A vaccine consists of a suspension of the living or dead bodies of bacteria in physiologic salt solution or an oily excipient. The virulence of the living germs is attenuated either by a physical agency (room temperature, sunlight, the ultra-violet rays, or exposure to 56-60° C.) or a chemical agency (ether, sodium fluoride, iodine, etc.). When dead bacteria are employed, they may be killed by the same means and the vaccines are then prepared either with bacterial bodies or with their autolysate (bacterial extract). An autolysate is a maceration of bacteria. Thus, in the case of the typhoid bacillus, 24 to 48 hour cultures on agar are taken and allowed to macerate, in the live state, in salt solution at 38° C. The duration of the autolysis is from twenty-four to forty-eight hours, according to the strength of the preparation one desires to obtain. At the expiration of this period the autolysates are centrifugated and then sterilized by the addition of ether. When the vaccine is to be used, the ether is gotten rid of by heating on a water bath at 38° C.

The numerical content of bacteria is adjusted either by actual counting of the germs (*e.g.,* with the use of a hemacytometer) or by the weighing of a rather larger number of germs concentrated by centrifugation and then diluted in a known volume of fluid.

There are two general methods of preparation, affording the *vaccines made by the method of Wright,* and the *soda vaccines of the Mauté type.* To the former may be added:

(a) **Besredka's Sensitized Vaccines.**—These are heated and killed cultures that have been impregnated with their antibodies or amboceptor. Any germ, when placed in contact with its antiserum (or with blood plasma from an organism infected with the same germ), fixes the corresponding antibodies or amboceptor in it, and does this to the exclusion of any other substance contained in the serum. The

bacteria can then be removed from the serum in which they have been immersed, and washed with physiologic salt solution; they remain nonetheless impregnated with the antibodies. These vaccines are *non-toxic* and produce no constitutional reaction. Furthermore, they notably favor phagocytosis of the bacteria concerned, and no local disturbance is to be feared at the site of their injection. These sensitized vaccines present marked advantages; they possess both the property of rapid immunization exhibited by serums and the lasting immunization afforded by vaccines.

(b) **Lipovaccines.**—The underlying principle of the lipovaccines, as prepared by Le Moignic and Sézary, consists, in the first place, in the use of bacteria as free from damage as possible, and secondly, in their suspension in an oily menstruum such that, while preserving the immunizing properties of the antigen, it hinders the manifestation of its most severe toxic effects. The substitution of an oily menstruum for an aqueous one results in a very marked slowing of the absorption and, therefore, permits of the injection of a much larger number of bacteria at one time.

Soda Vaccines, Mauté type.—These are stock vaccines or autogenous vaccines. Mauté thus prepares staphylo-soda, strepto-soda, coli-soda, etc., vaccines. In general, they correspond to 1 milligram of bacteria per cubic centimeter for intravenous injections, and 10 milligrams for subcutaneous injections. Mauté recommends, for curative treatment, intravenous injections of stock vaccines, *e.g.*, 0.5 cubic centimeter for the first injection; 2 days later, 0.67 cubic centimeter; 2 days later, 1 cubic centimeter. Then, if the temperature has not become normal, a 1 cubic centimeter injection on alternate days is continued as needed. For preventive purposes, subcutaneous injection of autogenous vaccine is preferred. The injections can be spaced 6 to 8 days apart.

VACCINE DOSAGE.—Such dosage is a particularly delicate matter, and to carry out vaccine therapy with complete accuracy, *the opsonic method is frequently necessary.*

The object sought is, in brief, to bring about the greatest and most prolonged increase possible in the *opsonic index, i.e.*, the positive reaction or phase, and the least and shortest possible negative reaction (or diminution of the opsonic index, which, as is well known, always precedes the positive phase). From the practical standpoint, it is not absolutely impossible to regulate this reaction by purely clinical means, as Jameson has demonstrated in the case of gonococcal infection. This is likewise the opinion of Mauté.

In each individual case, the most rational procedure consists in first administering a dose certain to be harmless (*e.g.*, 0.25 c.c.), and then gradually increasing it (generally by 0.5 c.c.) in the succeeding days (48

hours later, as a rule) until there results a slight and brief negative phase manifested clinically, in a general way, by a temporary and mild recrudescence of the symptoms. This dose is adhered to as long as the subject reacts to it; then the dose is increased again. If, perchance, the patient should react to the initial dose, this dose is repeated three days later, and care is taken not to go beyond the initial dose as long as it is not perfectly borne.

No injection is repeated until the reaction produced by the preceding one has disappeared for twenty-four hours. As a rule, two or three injections a week are given.

It must be admitted that this matter of dosage is still very uncertain. One is amazed, in reading the accounts of different observers relating, *e.g.*, to gonococcic vaccine, to note the enormous variations in dosage, ranging from a few millions to hundreds of millions or even billions (Miller, Jameson). These discrepancies are evidently due in part to the different varieties of gonococci and the different procedures followed in the preparation of stock vaccines.

It may be stated, as a general rule, that in acute conditions the intervals between injections should be shorter (two or three days) and the doses smaller than in chronic conditions (seven to ten days). In most cases, indeed, the patient will himself give the word as to the time when the positive period, corresponding to improvement, has terminated; the injection should be repeated shortly before this time.

Hypodermic administration is the procedure of choice. The oral and rectal routes have so far proven ineffective [except in the case of typhoid fever, in which Besredka and Vaillant have shown the feasibility of vaccination by the mouth by means of heat-killed bacilli preceded by a bile pill; dysentery is also being successfully prevented in this way.—Tr.].

TECHNIC OF HYPODERMIC VACCINE INJECTION.—(*a*) Apparatus.—A glass syringe of 2 to 5 c.c. capacity should be used, and, if a lipovaccine is to be given, a needle of rather large caliber (1 millimeter).

These should be sterilized by boiling for ten minutes and allowed to cool before use.

None of the instruments should be moistened with water; for if the lipovaccine is being used the bacteria, passing readily from the oil into the water, will then be absorbed more rapidly, thus defeating the object of the method.

(*b*) Procedure.

I. Shake the ampule *vigorously* for about a minute.

II. Break the ampule at its neck by making a scratch on it with a file and striking a sharp blow on the tapered end with scissors, a

key, or some such object. Tincture of iodine may be applied to the neck of the ampule beforehand. In any case, no flame should be applied to the ampule, as it might produce undesirable changes in the contents.

III. Under strict aseptic precautions, draw up the dose of vaccine into the syringe.

If a stock vaccine is being used, two ampules are employed, one containing the vaccine, the other physiologic salt solution; 0.5 c.c. of the vaccine and 1.5 c.c. of salt solution are used.

IV. Inject into the subcutaneous cellular tissue of the deltoid region, preferably on the left side, rather high up and slightly posterior, two fingerbreadths above the acromion. Some workers select the subclavicular region.

With the patient seated, after the skin has been painted with iodine, the needle is introduced for a distance of about 2 centimeters. One should make sure that it has penetrated well beyond the dermis, that it has not passed into the muscles (mobility beneath the skin), and that no blood is exuding.

V. Inject the fluid *slowly*. Do not carry out massage over the area. Merely apply a dossil of cotton or sterile gauze over the puncture and have the patient hold it there to prevent any possible escape of the injected fluid.

VI. On the day of the injection and that following, if the injection is for prophylactic purposes, the subject should avoid all fatigue. His diet should be light. He should not expose himself to cold. The giving of acetylsalicylic acid is unnecessary. The patient should be warned that he may experience a feeling of numbness and that his temperature may rise slightly.

Possible Toxic Manifestations Following the Use of Vaccines.—These may be divided into four groups: Febrile reaction alone; febrile reaction with slight toxic symptoms (malaise, loss of appetite, sleeplessness); febrile reaction with toxic symptoms of intermediate severity (backache, headache, vomiting, weakness, etc.); febrile reaction with serious toxic symptoms (ataxo-adynamic phenomena, vaccine shock).

II. PREVENTIVE VACCINE THERAPY.

The term vaccination, formerly referring merely to inoculation with cowpox in order to immunize the system against smallpox, is now applicable to any procedure having for its purpose to inoculate a mild disease in order to protect against a more serious one, and, more precisely, to the inoculation of a pathogenic agent in order to

protect the system against the disease which this pathogenic agent causes.

The various forms of vaccination now employed against the various diseases will be mentioned hereinafter.

As for the technic of the vaccine injections, it is the same as that described above for curative vaccine therapy, except in the case of vaccination against smallpox, next to be referred to.

VACCINATION AGAINST SMALLPOX.—To protect the human subject from smallpox, *vaccine* is inoculated, giving rise to a disease known as *vaccinia.*

VACCINE.—Smallpox vaccine now consists almost invariably of a **glycerinated vaccine pulp** of animal origin, prepared with the scrapings from vaccine pustules on calves.

This vaccine is obtained by the practitioner in small glass tubes sealed at both ends.

Wurtz and Camus have recommended a *dry vaccine* as being destined to prove of immense service in tropical countries. The dry vaccine is put up in sealed ampules. Before use the vaccine is ground in a mortar and very cold water containing glycerin is added drop by drop.

VACCINATION.—There are two procedures:

1. *Puncture.*

2. *Scarification.* The latter is preferable, especially with the glycerinated vaccine, which, being viscid, does not penetrate well and requires a considerable surface of absorption.

Either a lancet or a special *individual vaccinostyle* [or an ordinary needle], sterilized by boiling, may be used.

The practitioner should first wash his hands and then wash the patient's skin with boiled water and soap (no antiseptics).

The site selected for the procedure is the skin over the deltoid insertion in males and the root of the shoulder, or better, the outer aspect of the thigh or calf in females.

The vaccine having been taken up with the vaccinostyle, the skin is placed on a stretch between the left thumb and forefinger, and 3 light scratches (no blood should appear) made, 2 millimeters long and 3 to 4 centimeters apart. Each of these is covered with the vaccine. The subject waits for a few minutes before putting on his clothing. No dressing is required.

The *inspection for results* should be carried out on the fifth and the eighth days.

Indications for Vaccination.—The initial vaccination can be performed in the first few days of life. Vaccination may be abstained from, however, for six months or a year in debilitated or puny children.

In the event of an epidemic every one, without exception, should be revaccinated.

Contraindications.—Skin diseases, particularly eczema (except during an epidemic).

Duration of the Immunity.—Ten years, on an average. But it is better to revaccinate every five or six years.

Revaccination.—The scarifications are indispensable and are capable of yielding seven times as many "takes" as punctures.

When vaccination fails, or appears as a vaccinoid, it is well to revaccinate until the result is completely successful or a skin reaction is no longer produced.

* * *

ANTITYPHOID VACCINATION.—Three types of vaccine may be used for this purpose:

1. **The simple typhoid vaccine** (cultures killed by heat and an antiseptic).

Three injections of 0.25, 0.5 and 0.75 c.c. of vaccine, respectively, are made at weekly intervals. [In America the three doses consist generally of 500, 1000 and 1000 million bacilli, each dose being of 1 c.c. volume.]

In children, the doses are smaller, *e.g.*, ¼ dose for a child of seven to twelve years; ½ dose for one of twelve to fifteen years, and ¾ dose for one of fifteen to seventeen years.

2. The **T. A. B. (triple) vaccine** (macerated living cultures, killed by ether—Vincent—or other antiseptics, of both the typhoid and the A and B paratyphoid bacilli).

Four injections of 0.5, 0.75, 1 and 2 c.c., respectively, were originally given, at weekly intervals. [Usual dosage in America, 0.5, 1 and 2 c.c.]

3. The **T. A. B. lipovaccine,** a mixed vaccine with an oily menstruum, immunizing both against typhoid and the paratyphoid infections.

The vaccination is carried out with a *single injection* of 1 c.c. The T. A. B. lipovaccine of Le Moignic, Paris, is distributed in sealed ampules of 1, 5, and 10 c.c., with glass beads intended to spread the contained bacteria uniformly when the ampule is shaken. On the label appears a final date after which the vaccine should not be used.

Necessary Precautions.—On the day of the injection and the following day, the patient should avoid all fatigue.

He should eat sparingly.

He should not expose himself to cold.

Administration of acetylsalicylic acid is unnecessary.

PRELIMINARY EXAMINATION OF PERSONS TO BE VACCINATED.—1. *Temporary contraindications* (requiring merely postponement of the injection):

Overwork. Depression.

Febrile conditions.

Acute diseases. Infections, such as sore throat or the eruptive fevers.

Intoxications, in particular acute alcoholism.

2. *Permanent contraindications* (very exceptional, in theory, among soldiers fit for active service):

Poorly compensated organic heart lesions with persistent tachycardia.

Confirmed tuberculosis.

Chronic lung disorders that may react on the heart (emphysema, asthma, chronic bronchitis).

Renal insufficiency accompanied by an albuminuria of 0.5 gram or more to the liter, by hematuria, by functional disturbances pointing to deficient elimination of wastes (headache, edema, digestive disturbances, dyspnea), or by high blood-pressure, with or without gallop rhythm.

Hepatic affections of malarial, alcoholic or lithiasic origin, etc., with or without jaundice; changes of volume and sensitiveness of the liver, and a hemorrhagic tendency.

All grave organic diseases.

REVACCINATION AGAINST TYPHOID.—This should be carried out at the end of one year, in the same manner as the initial vaccination.

Any subject who has gone through a typhoid disorder should be vaccinated one year after his recovery in the same manner as has already been described.

VACCINATION AGAINST ASIATIC CHOLERA.—Two methods are mainly employed:

1. **Ferran's Vaccine.**—This consists of pure bouillon cultures of comma bacilli, allowed to develop for two days, and living.

First injection: 1 c.c. in each arm.

Second injection, five or six days later: 1.5 c.c. in each arm. A third injection of 2 c.c. in each arm may be added with advantage.

In children below five years of age a one-half dose is used.

2. **Haffkine's Vaccine.**—Haffkine enhances and fixes the activity of the virus he uses by intraperitoneal injections of fatal doses in guinea-pigs, and by repeated transmission from one guinea-pig to an-

other. He then attenuates this fixed virus by successive inoculations on agar.

Each agar culture of vaccine may serve for the vaccination of ten to twenty persons. For this purpose, one simply introduces into the tube of vaccine 10 or 20 c.c. of sterile bouillon, rubs over the surface with a tube drawn into a point and closed at its extremity in order to detach the coating of bacteria, and shakes thoroughly to obtain as homogeneous a suspension as possible.

These two procedures are harmless, but their efficacy is still open to discussion.

VACCINATION AGAINST PLAGUE.—Various vaccines for protection against plague have been prepared.

(*a*) *Haffkine's lymph* consists of a bouillon culture killed by heat. The dose is 5 c.c.

(*b*) *Bacterial extracts.*

(*c*) *Heated exudates.*

(*d*) *Organs of animals that have succumbed to plague or been immunized.*

(*e*) *Attenuated living cultures.*

These vaccines cause much pain when inoculated under the skin. Accordingly, substitution of intramuscular injections is recommended.

The immunity produced persists for several months.

Antiplague vaccines are capable of restricting the morbidity to some extent, but do not eliminate plague in a country in which it is epidemic, as plague is mainly an epizootic affection of rats, which are the most active agents in its propagation.

VACCINATION AGAINST DIPHTHERIA.—The passive immunity conferred by the injection of antidiphtheritic serum is established almost at once, but lasts only a few weeks. On the other hand, the active immunity which follows administration of a vaccine, while coming on much more slowly, is far more durable and persists for several years; no doubt it is often permanent.

The labors of Behring and of Park and Zingher have shown that vaccination against diphtheria is not only possible but is capable of yielding very good results. The procedure consists in the injection into children of *a mixture of diphtheria toxin and antitoxin* so proportioned that the product injected is neutral or contains a slight excess of toxin or of antitoxin.

Already in 1914 Park and Zingher saw the advantage to be obtained from the Schick test for control purposes in active immunization against diphtheria. They began at that time a series of inves-

tigations which later led to the wholesale application of antidiphtheritic vaccination among the school children of New York.

III. LOCAL VACCINATION.

Immunizing Bouillon Cultures for External Dressings According to the Method of Besredka.—Besredka has propounded, in respect of antibacterial immunity, a new theory. Instead of accepting the view that vaccination is the result of the elaboration of antibodies by the organism, Besredka wondered if certain infections were not purely regional processes, causing on the spot lesions and reactions of which the general symptoms would be but a secondary consequence.

Local immunity, according to Besredka, is the immunity obtained by vaccination of a single organ, which, however, is generally accompanied by immunity of the entire organism. It is an immunity without antibodies. The organs defend themselves *in situ* against bacterial invasions and acquire immunity without any participation by the bodily humors.

It is in anthrax that local immunity is seen in its purest form. Anthrax is a local disease (of the skin cells) amenable to local vaccination. Lethal doses can be injected into fresh guinea-pigs, in the peritoneum or elsewhere, without making them ill. To this end, however, it is necessary to see that the skin be wholly spared during these manipulations. The anthrax bacillus, accordingly, does not attack all structures indiscriminately; anthrax infection is not a septicemia in the generally accepted sense of the term, but is a skin disease which leads to a fatal septicemia.

The guinea-pig can be vaccinated against anthrax (which had been thought impossible with the methods of injection previously employed), but it must be vaccinated by the cutaneous route, and not by the subcutaneous or any other route.

Vaccinia offers another example, less pure, it is true, of a local affection.

Dysentery, typho-paratyphoid affections, and cholera, are diseases whose principal seat is in the intestinal wall. It is toward the latter that the viruses, upon penetrating into the system, travel in great part. It is in this intestinal wall that these viruses, transformed into vaccines, create local intestinal immunity.

When we take a guinea-pig, with the fur removed from the ventral surface, and apply around its trunk a compress moistened with antistaphylococcus vaccine, its resistance to inoculation of the staphylococcus under the skin becomes considerably increased.

The immunity of the animal after the application of the dressing is established with a rapidity the equal of which does not exist in so-called

general immunity: It is clearly manifested within 24 hours following the application.

Still more pronounced results are obtained when the vaccine ordinarily employed, *viz.*, the bodies of staphylococci, is replaced by a culture in filtered bouillon. This liquid is non-toxic. While endowed with but very weak protective power when injected subcutaneously, and proving a little stronger when given intracutaneously, this filtrate protects with an unforeseen power when it is applied to the depilated skin of the guinea-pig in the form of a dressing.

The immunity appears rapidly: Twenty-four hours most often suffice. The vaccinating power of the dressing soaked with the filtered culture is superior to that following the injection of bacterial bodies under or into the skin.

Identical observations have been made with the streptococcus.

Clinicians have not been slow to follow up this conception of vaccine therapy, and have proceeded to carry out similar tests in man. At the present time, compresses soaked in filtered cultures are in daily use in the most varied conditions: Boils, carbuncles, whitlow, phlegmons of the hand, abscess of the auditory canal, mammary abscess, dacryocystitis, blepharitis, osteitis, osteomyelitis, various suppurative processes with or without fistulous tracts, streptococcic pleurisy, peritonitis, puerperal fever without placental retention (intra-uterine applications).

These specific dressings are rather often proving to be much more effective than injections of vaccine under the skin.

There are on the market bouillon-vaccines for antistaphylococcic dressings, antistreptococcic dressings, etc., for local, cutaneous, intra-uterine applications, etc.

Enterovaccines.—The labors of Besredka have shown that when animals are made to ingest killed cultures along with bile, they become definitely immunized and resist fatal inoculations of the virus. This has led to research in man for a local vaccination *per os* with enterovaccines against typhoid and paratyphoid infections, bacillary dysentery and cholera. (Lumière enterovaccines; T. A. B., anti-Shiga bacillus, or anti-cholera bilivaccines). They are prepared in the form of tablets, accompanied (in the case of the bilivaccines) by beef pills. One vaccine tablet is taken fasting one hour before breakfast and preceded by the ingestion of a beef pill, for three days. No febrile reaction occurs, and there are no contraindications. Immunization is stated to be rapid, being complete within the 24 hours following the ingestion of the third tablet. The duration of the immunity is still in some doubt (6 months to a year). These results are still under discussion.

VACCINE THERAPY.

DISORDERS TREATED BY VACCINE THERAPY.	INDICATIONS AND CONTRA-INDICATIONS.	VACCINES USED.	DOSAGE.	REACTIONS. UNTOWARD RESULTS.	THERAPEUTIC RESULTS.
Actinomycosis.	—	*Stock vaccine or autogenous vaccine.*	Hypodermic injection of 5 to 7 million germs weekly.	—	*Still problematical.*
Acne.	Pustular acne. Comedones.	*Staphylococcus vaccine and acne bacillus vaccine (microbacilli of Sabouraud) should be given simultaneously.*	Initial hypodermic dose { Microbacilli: 5 to 10 million. Staphylococci: 100 to 200 million. }	—	*In spite the very good results in some cases, only temporary improvement is obtained, as a rule.* *In acne without inflammation, when comedones are present the acne bacillus is stated by some observers to be very effective.*
Arthritis, Infective. **Gonorrhea** (see *Gonococcic Infection*).	—	*Streptococcus vaccine: Usually an autogenous vaccine; Besredka's sensitized vaccines have been used; also polyvalent lipovaccines.*	Hypodermic injection every 2 or 3 days at first: 1st injection: 50 million. 2d injection: 50 million. 3d injection: 100 million. Thereafter: 300 million and up to 800 million, at least.	Distinct temperature reaction. Increased local pain.	*Inconstant.*

Asthma.	Indicated in asthma the etiology of which is related to infections (C. Jones), to bronchitis.	*Autogenous vaccine.*	—	—	*Very questionable.*
Bacillary Dysentery.	Indicated in dysentery due to Shiga bacilli or aberrant types of bacilli.	*Iodized autogenous vaccine or Shiga bacillus stock vaccine.*	Hypodermic injections: 1 c.c. = 50 million bacilli. 1st injection: 0.25 c.c. 2d injection: 0.5 c.c. 3d injection: 1 c.c. 4th injection: 1.5 c.c. Injections given daily or at longer intervals.	Slight local reaction.	*In dysentery of the Shiga type the number of stools drops in 3 days from 50 to 0 or to 5 or 6. Marked general improvement. Analogous results in dysentery due to bacilli of aberrant types.*
Empyema.	—	*Streptococcus vaccine.* (See *Arthritis, infective.*)	(See *Arthritis, infective.*)	(See *Arthritis, infective.*)	*Inconstant.*
Erysipelas.	Acute erysipelas is in particular influenced by the vaccine. Recurring erysipelas is not influenced.	*Streptococcus vaccine.* (See *Arthritis, infective.*)	(See *Arthritis, infective.*)	(See *Arthritis, infective.*)	*Inconstant.*
Folliculitis. Furunculosis. Carbuncle.	—	*Autogenous vaccine, when possible. Sabouraud advises a 24 or 48-hour agar culture diluted in 20 c.c. of 0.65 per cent. salt solution and heated to 62-65° C. for 1 hour. 1 c.c. = 500 million staphylococci. Stock vaccine, polyvalent: 1 c.c. = 250 million staphylococci.*	Hypodermic injections. 2 injections weekly; 4 to 10 injections altogether. Begin with 0.25 c.c.; then 0.5, 0.75, and 1 c.c.	No local or general reactions.	*Furuncles are distinctly influenced, tending toward a fluid and copious suppuration favoring elimination of the necrotic core. Carbuncles are very favorably influenced. In recurrent furunculosis of the nuchal region and back, results are uncertain, often unfavorable.*

VACCINE THERAPY (*continued*).

DISORDERS TREATED BY VACCINE THERAPY	INDICATIONS AND CONTRA-INDICATIONS.	VACCINES USED.	DOSAGE.	REACTIONS. UNTOWARD RESULTS.	THERAPEUTIC RESULTS.
Gingivitis. Pyorrhea alveolaris.	—	*Streptococcus vaccine.* (See *Arthritis, infective.*) [Also sometimes *mixed vaccines.*]	(See *Arthritis, infective.*)	(See *Arthritis, infective.*)	*Results questionable.*
Gonococcus Infection.	Indicated mainly in gonorrheal rheumatism, orchitis, salpingitis, cystitis, and conjunctivitis (Sauvineau). Urethritis is the most refractory manifestation.	*Stock vaccines, polyvalent. Nicolle and Blaizot have devised a polyvalent vaccine consisting of a stable solution which contains several strains of gonococci and the synococcus, a new germ isolated from gonorrheal cases. 0.5 c.c.=25 million gonococci + 225 million synococci. Antigonococcic lipovaccine.*	Subcutaneous, or better, intramuscular injection. Nicolle and Blaizot's vaccine: Generally 6 injections of 0.5 c.c. on alternate days or daily in serious cases. Lipovaccine: Up to 30,000 million at a dose.	No local nor general reaction.	*Results still questioned. Satisfactory, but inconstant, results have been obtained mainly in gonorrheal rheumatism and arthritis.*
Influenza.	Indicated mainly in influenza with complications affecting the lower respiratory tract.	*Vaccines made up of the various germs constantly found in the sputum, blood, stools, or pleuritic fluid of influenza cases (pneumococcus, enterococcus, streptococcus).*	Hypodermic injections of ¼ c.c. Increase daily by ¼ or ½ c.c. up to 1½ c.c.	—	*Results questionable.*
Lethargic Encephalitis, Progressive.	—	*Levaditi's virus-vaccine.*	Intraspinal or intramuscular injections.	Intraspinal injection sometimes induces very intense reactions.	*Results inconstant.*

Lymphangitis. Phlegmonous processes. Erysipelas. Osteomyelitis. Salpingitis. Phlegmonous sore throat.		*Delbet's vaccine (staphylococci, streptococci and pyocyaneus organisms).*	Three injections at 3-day intervals. Adult dose: 4 c.c. Dose at 13 years: 3 c.c. Dose at 10 years: 2 c.c. Dose at 3 years: 1 c.c.	Sometimes marked constitutional reaction (chill, fever, etc.).	*Good results have sometimes been observed in predominantly septicemic conditions (endocarditis, puerperal infections).*
Mastoiditis.	—	Streptococcus vaccine. (See *Arthritis, infective.*)	(See *Arthritis, infective.*)	(See *Arthritis, infective.*)	*Inconstant improvement.*
Meningitis, cerebrospinal.	Indicated in cases in which serum therapy fails to cause rapid recovery.	*Autogenous vaccine sterilized by iodine, or cultures of meningococci on eggglose; suspension in physiologic salt solution heated to 55° C. for 30 minutes. 1 c.c. = 500 or 1000 million.*	Hypodermic injections: Large doses every 3 days. 1st injection: 500 million. 2d injection: 750 million. Then, 1000 million and even more.	—	*In a few cases, marked improvement of general and local symptoms. Sometimes no result.*
Peritonitis, circumscribed.	—	*Streptococcus vaccine.* (See *Arthritis, infective.*)	(See *Arthritis, infective.*)	(See *Arthritis, infective.*)	*Inconstant improvement.*
Pertussis.	—	*Stock vaccines, simple or combined, 1 c.c. = 4000 or 5000 million.*	Hypodermic injections at 2 or 3-day intervals: 0.25 to 1.5 c.c.	—	*Inconstant.*
Phlegmonous processes. Adeno-phlegmons. War wounds.	—	*Delbet's mixed stock vaccine bouillon.* *Polyvalent serum of Leclainche and Vallée.*	(See *Arthritis, infective.*)	(See *Arthritis, infective.*)	—

VACCINE THERAPY (*continued*).

DISORDERS TREATED BY VACCINE THERAPY.	INDICATIONS AND CONTRA-INDICATIONS.	VACCINES USED.	DOSAGE.	REACTIONS. UNTOWARD RESULTS.	THERAPEUTIC RESULTS.
Pneumonia and Broncho-pneumonia.	—	*Pneumococcus stock vaccine.* [*Combined vaccines containing in addition streptococci and the pneumobacillus may also be used. 1 c.c. =3000 million germs. Dose, 0.25 to 1 c.c. at 2 or 3-day intervals.*]	Hypodermic injections: 5 to 10 million. In localized pneumococcus infections, the dose is rapidly increased to 50, 80 and 100 million. [Some give much larger numbers, even for prophylaxis alone, such as 1500 to 4500 million.]	—	*Injected on the second or third day it at times yields surprising results, but only very inconstantly.*
Pyelonephritis. Bacteriuria. Colon bacilluria.	Indicated in pyelonephritis due to: 1. Staphylococcus, or 2. Colon bacillus.	1. *Staphylococcus vaccine.* 2. *Autogenous colon bacillus vaccine.*	1. Staphylococcus vaccine: Rather large doses, beginning with 200 to 300 million hypodermically every 5 or 6 days, then rapidly increased to 800 or 1000 million or even more. 2. Colon bacillus vaccine: 10 to 100 million.	—	*Results inconstant.*
Pyemia. Septicemia. Synovitis.	—	*Streptococcus vaccine.* (See *Arthritis, infective.*)	(See *Arthritis, infective.*)	(See *Arthritis, infective.*)	*Inconstant improvement.*

Sycosis.	—	*Streptococcus vaccine.* (See *Folliculitis.*)	(See *Folliculitis.*)	(See *Folliculitis.*)	*Results inconstant.*
Tuberculosis, pulmonary.		*Mixed vaccine (streptococci, staphylococci, pneumococci and enterococci) against the coexisting secondary infections.*			
Typhoid and Paratyphoid Fevers.	*Indications:* Typhoid fever. Paratyphoid fevers, A and B. *Contraindications:* Intestinal hemorrhage, even slight. Slight albuminuria does not contra-indicate, provided the doses are not too large and the vaccine used is not too toxic; marked splenic enlargement.	*Simple typhoid vaccine. Triple vaccine. Autolysate (Vincent). Cultures attenuated by the ultraviolet rays (Renaud). Cultures attenuated by iodine-iodide solution (Ranque and Sénez). Sensitized vaccine (Besredka).*	Hypodermic injections. Dose: 100 to 500 million bacilli. Number of injections: 2 to 4. Intervals between injections: 12 to 48 hours. [The usual practice in America is: 3 injections at weekly intervals: 500, 1000 and 1000 million typhoid bacilli. If a triple vaccine is used: 1250, 2500 and 2500 mixed bacilli.]	Rupture of the spleen. (Before injecting vaccine it is well to percuss the spleen. If the spleen is too much enlarged, the injection should not be given.) Recrudescence of appendicitis. Reduction of blood-pressure (inject adrenalin simultaneously).	*Vaccine treatment makes the disease milder, reduces mortality, shortens the course, hastens convalescence, reduces the frequency of complications and likewise that of relapse, especially in children.*
		Triple lipovaccine (Le Moignic). There is thus a great variety of vaccines; those serving for prophylactic inoculations are generally used.	A single injection of 1 to 2 c.c.		

BACTERIOTHERAPY.

LACTIC FERMENTS.

Bacteriotherapy is represented mainly in the use of lactic ferments or bacilli.

The **considerations underlying lactic bacillus therapy are as follows:**

1. *In acute or chronic infections of the intestine,* aside from the specific pathogenic organism ordinarily absent from the bowel but liable to be brought there by contamination, to develop and to give rise to a specific type of enteritis (typhus bacillus, comma bacillus, dysentery bacillus, etc.), *there are oftenest found predominating in the intestinal flora the proteolytic organisms, destroyers of albumin, such as B. proteus vulgaris, B. mesentericus, B. subtilis, B. fluorescens liquefaciens, etc.*

2. *There is antagonism between the lactic bacilli and the proteolytic organisms.*

The former are more or less strictly aërobic, depend mainly on carbohydrates for their sustenance, and give rise to acid fermentations (lactic acid); the latter are more or less strict anaërobes, depend mainly on the proteins, and give rise to basic putrefactive processes (ammonia, complex amins and ptomains).

3. Correlation of the two foregoing propositions suggests, and clinical observation shows, that *the administration of the lactic organisms, in conjunction with a suitable carbohydrate diet, exerts a favorable effect on the acute and chronic infections of the digestive tract.*

This procedure, applied to infantile enteritis, to the enteritis of older children, and finally to adult forms of enteritis, has yielded notable results, manifested in the following characteristic phenomena:

(a) *Modification of the intestinal flora.*—More or less rapid elimination of the proteolytic pathogenic species, substitution by the acid lactic ferments, and finally, reappearance of the normal flora (this last phase is especially distinct in infants).

(b) *Gradual disappearance of the clinical evidences of gastrointestinal infection* (pain, diarrhea, mucus and pseudo-membranes, etc.).

Diarrhea or constipation ceases, as does likewise the pain. The foul odor of the stools disappears; the tongue becomes clean and the temperature subsides to normal.

(c) The *sulphoconjugate esters of the urine diminish and the constitutional disturbances generally ascribed to auto-intoxication* (nervous, cardiovascular and pulmonary, urinary disturbances, etc.) thereupon also pass off.

This seems to be the essential mode of action of the lactic ferments, but it is probably not the only one, and it is not an exclusive property of theirs, as restriction to water, followed by a carbohydrate diet for a varying period of time, is ordinarily sufficient to give the above-mentioned results; there is no doubt, however, that in general the administration of the lactic bacilli notably hastens the curative process. The fact should not be overlooked, furthermore, that a carbohydrate diet and the lactic ferments are both essential—if not, indeed, inseparable—factors in lactic bacterial therapy.

MODE OF ADMINISTRATION OF THE LACTIC FERMENTS.—The lactic ferments may be given in liquid cultures, in milk (clotted milk, kephyr), in pepto-lactose bouillon (various lactic bouillons), or in dried cultures.

These three procedures, which in the last analysis include all others (kephyr, powder, tablets, globules, etc.), are far from being mutually equivalent.

1. **Kephyr, Koumiss and Yoghurt.**—These are foods which are mainly of service as constituents of the diet where treatment is of long duration. *While remedies of the first order in abnormal states characterized by insufficiency of diastase, they must give way to the next group of products as anti-infectious agents.*

Curdled milk may be prescribed as a food either independently of or along with carbohydrate foods (honey, sugar, preserves, etc.), to the amount of ¼ to 1 liter (quart) a day. If, for some reason, reduction of the content of fats and casein is desired, it should be prepared with skimmed milk.

2. **Lactic and Paralactic Bouillons.**—These are for the most part cultures in lactopeptonized bouillons of lactic or paralactic bacilli previously selected, sorted and activated by cultivation, sometimes in association with other bacterial species [*B. acidi paralactici* and *B. acidi bifidus* (Tissier), bacillus of Massol and the Oriental lactic bacillus (Fournier), etc.].

They are generally prescribed in doses of one wineglassful at the beginning of the principal meals, in the morning and evening, either alone or mixed with water containing lactose or with beer or cider. Some preparations are put up in small one-dose bottles, thus certainly obviating the risk of contamination in the course of the manipulations necessitated by the use of a single bottle for several days.

These are of superior efficacy as antiputrefactive agents. By combining them with a more or less strict carbohydrate diet, one obtains, sometimes with amazing rapidity (one might say immediately in the normal subject) deodorization of the stools, suppression of gas formation, and

regulation of the bowel movements. The rapidity and certainty of their action make of them the emergency agents in lactic bacterial therapy; these are the preparations which are particularly suitable in *acute enterocolitis* or in the *acute exacerbations of chronic enterocolitis.*

3. **Powders, Tablets and Globules.**—The *dried cultures* are marketed in these three forms. They consist of very active cultures, dried with the usual precautions and variously mixed with substances such as lactose, calcium carbonate, etc., having for their purpose to insure preservation of viability of the bacilli.

The relatively slow action of the dried cultures, which is really in no way disadvantageous in the chronic cases, is compensated for in practice by the fact that such administration (powder, tablets, or globules) is very easy and relatively inexpensive and that, as these cultures are of small bulk, the treatment can be continued while travelling.

Conservation of viability, however, does not appear to be indefinite. In the United States it is legally required that the date of manufacture shall appear on such dried preparations, and that they shall not be sold after the expiration of one year.

The dry form thus seems to be indicated mainly in *chronic enterocolitis,* in *intestinal auto-intoxication,* and for practical reasons in non-sedentary patients.

Whatever be the form of administration selected (curdled milk, bouillon, dried cultures, lacteol, lactobacillin, etc.), there must, in order to favor intra-intestinal development of the lactic bacilli, necessarily be provided for them their preferred pabulum, *viz.,* a diet rich in sugar: Vegetarian diet, or a mixed diet with marked vegetable predominance. Once more let it be repeated that a carbohydrate diet and the lactic ferments are both essential factors in lactic bacterial therapy.

[**Bacillus acidophilus.**—This is one of the main inhabitants of the intestine of nursing infants, and is asserted to be capable of more rapid growth in the bowel than *B. bulgaricus.* By far the best preparation of it, according to Rettger and Cheplin, is a 24-hour milk culture, of which 1 quart, with 100 grams (3⅓ ounces) of lactose shaken into it, may be given daily in 3 doses, always 2 hours away from the meals. In constipated cases, more lactose may be used; in cases with diarrhea, less. Among the indications given for this measure are: *Chronic constipation* with symptoms of *auto-intoxication, chronic diarrhea* following bacillary dysentery, *mucous colitis, sprue,* and *eczema.*—Tr.]

D'HERELLE'S PHENOMENON.—BACTERIOPHAGY.

In 1917 d'Hérelle described the following observation:

Given a 24-hour culture of the Shiga dysentery bacillus in alkaline peptone bouillon and some filtrate (Chamberland filter) of stools of a convalescent from dysentery, a few drops of this filtrate will clear up within a short time (6 to 18 hours at 37° C.) the cloudy bacterial suspension, and the suspension thus cleared exhibits two singular properties:

1. It no longer contains any dysentery bacilli: The dysentery filtrate has destroyed these; bacteriolysis has occurred.

2. The bacteriolyzed suspension possesses the same bacteriologic properties as the dysentery filtrate itself. It will cause the same bacteriolytic clarification in another bacterial suspension. This second clarified suspension exhibits the same bacteriolytic properties, and so on indefinitely.

D'Hérelle ascribes this phenomenon to an ultra-microscopic organism, *Bacteriophagum intestinale*, a new filtrable germ which is the virus of a transmissible and fatal disease of the dysentery bacilli.

The phenomenon has been confirmed by many experimenters and is not open to doubt. Interpretation of it, however, has been the subject of many controversies, in particular that of Bordet and Ciuca, who look upon the phenomenon merely as an instance of a transmissible process of humoral serum autolysis.

It has been thought advisable to mention the phenomenon here because there is no doubt that it may be the starting-point of some interesting diagnostic and therapeutic applications.

In this connection d'Hérelle has expressed himself thus (*Presse méd.*, June 11, 1921):

"Whenever an intestinal disturbance arises in a previously healthy individual, however slight be this disturbance, one can isolate from the stools, as soon as the disturbance is improving, an active bacteriophage against one or another of the intestinal bacteria. Whenever the bacteriophage manifests its activity toward some bacterium, this can only be the indication of a beginning infection, sometimes so mild that it may even pass unnoticed and is then detected only through the appearance of an active bacteriophage: In all cases the disease aborts by reason of a rapid adaptation of the intestinal bacteriophage to bacteriophagic activity in respect of the causal pathogenic bacterium; all these bacteria are destroyed before they have been able to multiply.

"Immediate adaptation is the rule in the case of the endemic diseases; eventually, however, it may fail to occur by reason of intestinal conditions unfavorable to the bacteriophage: The pathogenic bacterium then develops unhindered and the disease sets in. The course of a case of bacterial disease is a reflection of the ups and downs in the combat joined in the system between the pathogenic bacterium and the bacteriophagic ultra-microbe. If the adaptation to bacteriophagy in respect of the invading germ takes place in time, the patient becomes convalescent and the duration of the disease corresponds merely to the time required for habituation; if it takes place too late or fails to occur, the patient succumbs. I have always been able to isolate at the beginning of convalescence an active bacteriophage against the causal pathogenic bacterium; I have never succeeded in isolating one in the patients who have succumbed.

"In all the diseases which I have so far studied, whether occurring in man or in animals; whether the disease be a purely intestinal one like dysentery, or one complicated with septicemia, such as typhoid fever, or a pure septicemia, such as hemorrhagic septicemia of the water buffalo, or a disease with lymphatic localizations, such as bubonic plague, one always observes, from the beginning of convalescence, the appearance in the stools of an active bacteriophage against the causal pathogenic bacterium—a bacteriophage which can be isolated and cultured indefinitely *in vitro* at the expense of this bacterium. This active bacteriophage does not exist as long as the disease is pursuing its active course; its appearance coincides with the first evidences of improvement; it is not found at any time in individuals who are to succumb.

"Now, since it is possible to cultivate *in vitro* an active bacteriophage against a given bacterium, and that in amounts as large as may be desired, it is possible to place sensitive individuals, at any given time, into the same refractory state in which the individuals who have become naturally immunized are. In other words, it is possible to vaccinate against a given disease, reproducing, in doing so, the natural conditions of immunity. This is exactly what observation shows: An animal to which is administered a small amount of a culture of an active bacteriophage against a pathogenic bacterium becomes refractory to the disease caused by this bacterium."

Among animals, in avian typhosis and in the hemorrhagic septicemia of the water buffalo, the results published by d'Hérelle (*loc. cit.*) seem quite conclusive.

As for the hopes that may be entertained in respect of treatment in human subjects, d'Hérelle has this to say (*loc. cit.*):

"In man, I tried treatment by ingestion of 1 c.c. of such a culture of the bacteriophage in 7 grave cases of dysentery; in these 7 cases, in 24 to 36 hours after such ingestion, the blood and bacilli disappeared from the stools, and convalescence set in, in the absence of all other medication. Bacillary dysentery is endemic in certain countries of Eastern Europe, Poland in particular; these observations show that it would be easy to eliminate the ravages of this disease, in a simple and harmless way; injection of any cultures of the bacteriophage, including the antidysenteric bacteriophage, do not cause the least reaction, local or constitutional, in either man or animals; immunity is, moreover, acquired from a single injection of a very small amount; we have seen above that 0.04 c.c., that is, one drop, is enough to immunize a water buffalo weighing 200 or 300 kilograms. Bubonic plague is another disease against which the method of immunization by cultures of the antiplague bacteriophage would be immediately applicable; I have isolated some strains of this bacteriophage which I am keeping in cultures; this would be all the more useful in that, as in dysentery, none of the procedures of vaccination now employed has given any result.

"With a procedure of immunization based on the theory of the bacteriophage as a cause of immunity, the proof of its efficacy must naturally be immediate: If this theory is correct, and all the experiments so far carried out are in favor of it, the epidemic must terminate abruptly in any locality the inhabitants of which have been immunized by means of an injection of a culture of the active bacteriophage against the causal bacterium, and this immediately after the immunization."

Time will show how much fruit one may expect to find borne by the seed represented in d'Hérelle's work.

CHEMOTHERAPY.

I.—ANTISYPHILITICS.

MERCURY. ARSENIC. IODIDES. SULPHUR.

Specific Treatment of Syphilis.—In the present state of clinical therapeutics, one may say that there are but four well-tried remedies for the treatment of syphilis.

Two are considered as actual specifics: *Arsenic* and *mercury*. Undoubtedly these exert an elective, specific action on the pathogenic agent, *viz., Spirochæta pallida,* and the clinical manifestations of syphilis. (The same appears to be true of *bismuth.*)

The other two are time-honored, though ***merely auxiliary***, remedies: *Potassium iodide* and the *sulphur compounds*. Their adjuvant action, favorable to therapeutic results, is undoubted under many more or less well-defined clinical circumstances. In any case, they exert no specific action. Even concerning the nature of their action little is as yet known. They are secondary, though sometimes useful, adjuncts.

ARSENICAL TREATMENT.—Only in relatively recent years has the antisyphilitic action of arsenic, barely suspected by the older observers, been recognized and availed of. This is due to the fact that this antisyphilitic action requires the giving of large, almost toxic amounts of arsenic, which can be given without risk, or at least with a relative degree of safety, only by means of the organic arsenical compounds, which are of comparatively low toxicity, and in particular by means of the organic arsenicals of the benzene series (arsenobenzol group) (see *Arsenic*).

At present this arsenical treatment is on a par with mercurial medication, if, indeed, it does not overtop it, in the treatment of syphilis. It may be considered specific in the same sense as mercury. After having even seemed about to supplant the latter, it is now associated and combined with it in a manner apparently altogether rational and warrantable.

It is now represented chiefly by:

1. **Arsphenamin** (arsenobenzol; salvarsan; 606).
2. **Neoarsphenamin** (novarsenobenzol; neosalvarsan; 914); dose, 0.15 to 0.9 gram.
3. **Galyl**; dose, 0.15 to 0.45 gram.
4. **Amino-arsenobenzol** (eparseno) (Pomaret-Jeanselme).

The first three of these compounds are mainly administered intravenously. One may, if strongly desired, give them by enema or even, in the case of neoarsphenamin and galyl, by intramuscular injection.

Amino-arsenobenzol is to be particularly recommended for intramuscular injection.

(For details as to the dosage, technic and plans of administration of these drugs, see the sections on *Arsenic, Intravenous Injections*, and *Syphilis*.)

Hectin (*benzosulphone arsanilid*) also possesses antisyphilitic properties, but these are much less definite than with the foregoing compounds. It is given by intramuscular injection in average daily doses of 0.2 to 0.4 gram. Its nutritive-tonic and hematopoietic actions over-

top its antisyphilitic action, and its use should therefore be reserved for torpid cases of syphilis with anemia and impaired nutrition. Ocular and aural involvements are considered as contraindicating its employment.

COMBINED ARSENICAL AND MERCURIAL TREATMENT.—In the section on *Syphilis,* we shall see how a combination of arsenical and mercurial medication is best carried out in the majority of cases.

BISMUTH MEDICATION.—Bismuth, the newest of anti-syphilitic remedies, is daily assuming greater importance. The reader is referred to the section on *Syphilis* for the details as to the various salts of bismuth employed, their dosage, and their mode of administration.

IODIDE MEDICATION.—Potassium iodide has lost a little of its former prominence as an antisyphilitic agent since the time when Fournier thought he saw in it a second specific for syphilis and attempted a specific treatment with the iodide alone—a procedure which he later deplored in terms so clear and simple that they are worth reproducing as a model of scientific honesty: "I indict myself for and am repentent on account of this error of my youth," etc. (A. Fournier, *Traitement de la syphilis,* p. 441).

Now divested of any true specific attribute, it is considered only as a possible auxiliary of mercury.

Following are its indications, according to Emery and Chatin:

Devoid of effect on the initial chancre, potassium iodide is capable of favorably influencing certain secondary manifestations which are ordinarily rather refractory to mercury; among these is the *secondary headache* of vesperal or nocturnal type, which disappears in a few days under the use of small doses (about 1 gram—15 grains—a day) of potassium iodide. The erratic and changeable *secondary neuralgias;* the *painful manifestations affecting the locomotor system* (bone pains, joint pains, muscle pains, periostitis, etc.); the *secondary syphilids,* dry, sluggish and *recurrent;* the *ulcerative syphilids,* especially pharyngeal or intranasal; *onychia,* and the *bone lesions* ordinarily refractory to mercury yield rapidly to mixed treatment. One should especially bear in mind, however, that the iodide may, on the contrary, be *pernicious in patients with syphilis of the larynx* and induce a congestion with edema which is sometimes fatal.

As for the tertiary manifestations, it is impossible to deny the action of the iodide on certain tertiary lesions. "Administered on account of gummatous processes, gummas of the skin and mucous membranes, syphilomas of the soft palate and back of the mouth, exostoses, hyperostoses, and ulcerogummatous lesions with phagedenic tendencies, treatment with potassium iodide benefits, attenuates and dissolves

them almost always with a really extraordinary rapidity and intensity of therapeutic action." (A. Fournier.)

(For information as to the administration of the iodide and its combination with mercury and arsenic, see *Iodine and Iodides* and *Syphilis.*)

SULPHUR MEDICATION.—Sulphur medication plays only an adjunct, though at times a singularly useful, rôle in the treatment of syphilis. While little is known as to the manner in which it acts, it seems to be recognized that sulphur medication favors the utilization and elimination of mercurial compounds, and that on this basis one may, by simultaneous application of sulphurous and mercurial treatment, make it possible to give doses of mercury otherwise impracticable and attended with risk. The nutrition of specific cases seems, moreover, to be improved by it. Finally, as a post-mercurial treatment, for the elimination of mercury, sulphur medication appears to exert a potent action.

Thus, clinically, sulphurous medication, chiefly represented by mineral-water cures at appropriate resorts, is especially indicated:

1. In syphilitics relatively *intolerant* of mercurial treatment.
2. Those subject to *mild recurrent symptoms refractory to treatment.*
3. In *severe manifestations* demanding *intensive mercurialization.*
4. In the presence of certain *localizations* known from repeated clinical observation to be *refractory and serious:* Psoriasiform syphilis, syphilis of the eye, laryngeal syphilis, fibrogummatous glosso-labio-jugal syphilis, glosso-jugal leukoplakia, and visceral syphilis in general, especially at the beginning of its course (arteritis, hepatitis, myelitis).
5. In *tabes dorsalis,* when the patient has been subjected to intensive mercurial treatment.

* * *

In conjunction with a progressive and intensive combined mercurial treatment, consisting of mercurial inunctions and daily injections of soluble mercurial salts (*e.g.,* 0.03 to 0.06 gram—½ to 1 grain—of the biniodide), the sulphur treatment consists essentially in the ingestion of sulphurous water (200 to 600 c.c.—6 to 20 fluidounces) and secondarily in inhalations and douches with massage.

Correct application of the sulphur treatment can hardly be expected otherwise than in the **special hydro-mineral resorts,** of which those with the best standing in France are Luchon, Uriage, Cauterets, Challes, Aix-les-Bains, and Saint-Gervais. These are almost exclusively summer resorts. As a winter resort Amélie-les-Bains may be

cited. [In the United States the following are among those available: Hot Springs, Ark.; Mount Clemens, Mich.; White Sulphur, W. Va.; Ballston, Saratoga, and Sharon, N. Y.,; Minnequa, Pa.; Blue Lick, Ky., and St. Helena White Sulphur, Cal.]

Some interesting results have been obtained in the treatment of syphilis by combination of mercurial treatment with subcutaneous or intramuscular injections of *colloidal sulphur.*

* * *

MERCURY.—Mercury in Syphilis.—Strictly speaking, the following propositions can alone be considered warranted at the present time:

1. The curative action of specific treatment with mercury or mercury and iodide in the active manifestations of syphilis in all its stages is nearly always effective and is daily becoming more so by reason of advances made in mercurial pharmacology.

2. The prophylactic action of the specific treatment against possible later manifestations is, up to the present, doubtful (I do not say *nil*) and insufficiently demonstrated.

For practical purposes, then, administration of mercury is *formally indicated during the periods of obvious syphilis;* it should be carried out in conformity with the rules and doses hereinafter to be mentioned, and it is rational to continue it for a few days, about a week or longer, after apparent disappearance of the symptoms. *During the periods of latency,* administration of mercury is of less obvious utility, and appreciation of its desirability can be, *up to the present time,* only a matter of altogether personal judgment and impression. For my part, I accept the practice of prolonged, systematic treatment.

There are two conditions, however, under which, whatever may be one's personal opinion regarding the preventive action of mercury, the treatment must be instituted without waiting for the appearance of actual symptoms.

1. *Before and during pregnancy, when the father or the mother or both are in the first years of their syphilitic infection,* and in particular, where they have shown secondary eruptions shortly before conception. In this connection the statistics of Fournier are absolutely conclusive: The mortality in the children is 82 per cent. among the untreated subjects, and drops to 3 per cent. among the treated subjects. On this point, furthermore, he is absolutely in accord with Diday.

2. The same applies in regard to the treatment of children with inherited syphilis who are the *offspring of recent syphilitics.* In these cases the indication for the treatment is based "either on the decrepit appearance of the child, or on the advent of syphilids, or simply on the weight curve, which shows an unaccountable, gradual and continuous loss of weight." (Boissard.)

Mercury in Conditions Other than Syphilis.—The "reflex" and "reversible" equation: Syphilis = mercury, and mercury = syphilis has—most unfortunately—cast a shadow over the other indications for mercury, which are of great significance.

Putting aside the three time-honored indications of *calomel* as a *cathartic, intestinal antiseptic* and *vermifuge,* I would like to direct attention to *three other indications*—not unknown, but *often overlooked*—of *mercurial medication in general, viz.,* its *action on the liver, antiseptic and cholagogue;* its *diuretic action, through stimulation of the renal epithelium,* and its *general antiseptic action.*

I. **Action on the Liver: Antiseptic and Cholagogue.**—The clinical action of calomel on the liver—calomel as "the digitalis of the liver"—is unquestionable and unquestioned. Its favorable action in benign infectious jaundice, in cirrhosis and in cholelithiasis is obvious, even though this action is not now explainable from the experimental standpoint; it can be accounted for only by an action on the liver cells and the biliary passages of a soluble mercurial product resulting from transformation of the calomel, which is insoluble. As a matter of fact, this property belongs to mercurial medication in general, whether carried out by the oral, subcutaneous, intramuscular or intravenous route, as I have observed in my specific patients. It is best availed of by rectal administration. I have improved or cured many a case of rebellious cholecystitis, caused many cases of infectious jaundice to yield, and arrested many cases of lithiasis by means of mercurial suppositories:

℞ Unguenti hydrargyri .... 0.04-0.06 gram (gr. ⅔-j);
Olei theobromatis .... 3 grams (gr. xlv).
Ft. suppos. No. i. Da tal. No. x.
Sig.: Insert one suppository on retiring.

The mouth and teeth should be carefully attended to.

The use of the suppositories is discontinued if diarrhea appears.

To my mind—*a priori* and *a posteriori*—this is the route of election, which is supported by the fact that absorption occurs through the portal system.

II. **Diuretic Action, Through Stimulation of Renal Epithelium.**—The diuretic action of calomel, "altogether surprising and *a priori* un-

likely" according to the pharmacologists, is *a posteriori* quite certain, as far as the clinicians are concerned. It is a fact that it is impossible not to ascribe it to some soluble mercurial compound—as yet unknown—resulting from the transformation of calomel *in vivo*. Like the preceding action, it is one of the features of mercurial medication in general, as any physician can easily ascertain for himself by a methodical study of diuresis before and after such medication. Is not, indeed, nephritis—a constant effect of severe acute mercurial poisoning—a characteristic evidence of this selective action on the renal epithelium?

Calomel, coupled if necessary with squill and digitalis; or the suppositories above referred to, or intramuscular injections of soluble salts, are the agents of choice in securing this diuretic action.

III. **General Antiseptic Action.**—It is not necessary to recall the rôle of mercury in ordinary antisepsis (bichloride, oxycyanide, etc.).

Mercury can be of great service in many non-specific infectious processes, such as infections of the biliary ducts or liver, pyemia, septicemia, furunculosis, adenitis, subacute infections, etc. Baccelli has recommended under these circumstances intravenous injections of 1 to 5 c.c. (16 to 80 minims) of a 1 : 1000 solution of mercury bichloride. Injections of mercury cyanide are equally to be recommended. For my part, I have often obtained the best results with the above-mentioned suppositories.

MODES OF ADMINISTRATION.

Pills.—To obtain mercurial action resort may be had to the time-honored salts of mercury, *viz.*, the bichloride in average doses of 0.02 to 0.04 gram (1/3 to 2/3 grain) a day, 0.01 gram (1/6 grain) being given in each pill; or the protiodide in average doses of 0.05 to 0.15 (3/4 to 2 1/2 grains) a day, 0.05 gram (3/4 grain) being given in each pill.

Dupuytren's pills (modified):

℞ Hydrargyri chloridi corrosivi .... 0.01 gram (gr. 1/6);
Extracti opii,
Extracti tritici ....āā 0.02 gram (gr. 1/3);
Glycerini .... q. s.
Ft. pil. No. i. Da tal. No. lx.

or:

℞ Hydrargyri chloridi corrosivi,
Extracti opii ....āā 0.01 gram (gr. 1/6);
Extracti cinchonæ .... 0.05 gram (gr. 3/4);
Glycerini .... q. s.
Ft. pil. No. i. Da tal. No. xxx.

or RICORD'S PILLS (modified):

℞ Hydrargyri iodidi flavi	0.05 gram	(gr. ¾);
Opii pulverati	0.02 gram	(gr. ⅓);
Glycyrrhizæ pulveris	0.03 gram	(gr. ½);
Mellis	q. s.	

Ft. pil. No. i. Da tal. No. lx.

or DANLOS'S PILLS:

℞ Hydrargyri iodidi flavi	0.03 gram	(gr. ½);
Extracti opii	0.01 gram	(gr. ⅙);
Extracti cinchonæ	0.05 gram	(gr. ¾);
Glycerini	q. s.	

Ft. pil. No. i. Da tal. No. lx.

All of the above pills should be prescribed in average daily amounts of two to three or four pills, to be taken at the beginning or near the end of the meals. In some cases it may be necessary to increase the dose to four or even five or six pills if the patient can tolerate them.

The *disadvantages of pill medication* are serious; the most important of them are the imperfect dosage of the active substance, the irregularity of absorption (old or poorly prepared pills may go through the digestive tract unbroken), and the irritant action exerted on the gastrointestinal mucous membrane. *The unreliability of their action is a very undesirable thing and should lead regularly to the discarding of this plan of treatment in the severe, rapidly progressive cases.*

The oral, cutaneous, hypodermic and intravenous routes each have their advantages and disadvantages. Their relative indications in the individual case depend upon the seriousness of the morbid manifestations, the social status of the patient, and special conditions relating to medical practice; it is only by a judicious analysis of these various features that the practitioner is enabled to make a rational selection of the method of choice in the individual case, *i.e.*, the procedure capable of giving the maximum therapeutic result with the minimum of inconvenience to the patient.

Mercurial Solutions for Internal Use.—Among the forms suitable for oral administration is a 1:1000 solution of mercury bichloride, or modified Van Swieten's solution:

℞ Hydrargyri chloridi corrosivi	1 gram	(gr. xvss);
Aquæ destillatæ	999 grams	(f℥xxxiv).—S.

Or, the biniodide may be prescribed in a syrup, *e.g.*:

℞ Hydrargyri iodidi rubri	0.1 gram	(gr. iss);
Potassii iodidi	10 grams	(ʒiiss);
Syrup aurantii amari	150 c.c.	(f℥vj).

M. Sig.: One to three tablespoonfuls a day, according to tolerance and the nature of the case.

Again, one might prescribe:

℞ Hydrargyri iodidi rubri .... 0.3 gram (gr. v);
Potassii iodidi .... 30 grams (℥j);
Solve in aquam .... 30 c.c. (f℥j), et adde:
Syrupi aurantii amari .... 300 c.c. (f℥xij);
Vini rubri (Malaga) ....q. s. ad 500 c.c. (f℥xvij). —M.

There is every advantage in substituting for this plan that of giving *fractional doses,* which consists in dividing the total amount (1 to 3 tablespoonfuls) into from 4 to 6 doses taken before meals and between meals (BROCQ).

Mercurial Injections.—*Preference should always be given to injections of the soluble salts of mercury.*—Among those most commonly used are the bichloride, biniodide, cyanide, benzoate [and salicylate].

BICHLORIDE.—This may be formulated as follows:

℞ Hydrargyri chloridi corrosivi .... 0.1 gram (gr. iss);
Sodii chloridi .... 0.075 gram (gr. i¼);
Aquæ destillatæ et bulliatæ .... 10 c.c. (f℥iiss).—S.

It will be noticed that the menstruum is simply physiologic salt solution. The daily dose is 2 to 3 c.c. (32 to 48 minims).

BINIODIDE.—On the basis of the previously-mentioned property of iodide solution, one might prescribe:

℞ Hydrargyri iodidi rubri,
Potassii iodidi ....āā 0.5 gram (gr. viiss);
Aquæ destillatæ ....q. s. ad 50 c.c. (f℥xiij). —S.

This would be used in an average daily dose of 2 to 4 c.c. (32 to 64 minims).

CYANIDE.—The cyanide of mercury, soluble in 8 parts of water, is prescribed thus:

℞ Hydrargyri cyanidi .... 0.1 gram (gr. iss);
Aquæ destillatæ .... 10 c.c. (f℥iiss). —S.

It is given by *intravenous* or intramuscular injection in doses of 0.005 to 0.02 gram (1/12 to 1/3 grain), *i.e.,* in doses of 0.5 to 2 c.c. (8 to 32 minims) of the 1 per cent. solution formulated above. The intravenous injections are recommendable by reason of their painlessness and rapidity of action. The intramuscular injections are rather painful, and it is well to combine stovaine [or procaine, 2 per cent.] with the mercurial, as in the following formula:

℞ Hydrargyri cyanidi,
Stovaine ....āā 1 gram (gr. xvss);
Aquæ destillatæ .... 100 c.c. (f℥xxvij).
S. Sig.: One to 2 c.c. (16 to 32 minims) a day.

OXYCYANIDE.—The oxycyanide meets the same indications, contains more mercury, and is less painful and less toxic. It is used like the preceding salt, to which it is to be preferred. The following solution may be recommended:

℞ Hydrargyri oxycyanidi	1 gram	(gr. xvss);
Liquoris sodii chloridi physiologici	100 c.c.	(f℥xxvij).

S. Sig.: One to 2 c.c. (16 to 32 minims) a day, by intramuscular or intravenous injection.

BENZOATE.—Bretonneau's formula may be used:

℞ Hydrargyri benzoatis	0.3 gram	(gr. v);
Ammonii benzoatis	1.5 grams	(gr. xxiiss);
Aquæ destillatæ et bulliatæ	30 c.c.	(f℥j). —S.

This is employed in a daily dose of 2 to 4 c.c. (32 to 64 minims).

The following isotonic sodium chloride solution may also be recommended:

℞ Hydrargyri benzoatis	1 gram	(gr. xvss);
Sodii chloridi (C. P.)	0.75 gram	(gr. xij);
Aquæ destillatæ	100 c.c.	(f℥xxvij).—S.

[SALICYLATE.—This is recognized in the U. S. Pharmacopœia, while the cyanide, oxycyanide and benzoate are not. It is used in a 10 per cent. suspension in oil, *e.g.*, oil of sweet almond, or in a lanolin emulsion, in doses of 0.6 to 1 c.c. (10 to 16 minims). It contains 54 to 59.5 per cent. of mercury, as against 74 per cent. in the bichloride. It is completely absorbed from the gluteal muscles in an average of 4 days (Cole), and is injected at 4-day intervals or twice weekly instead of daily.—TR.]

In the more serious manifestations of syphilis, the doses of mercury given can and should greatly exceed the customary amounts. Thus, Leredde proposes for these cases daily doses of 0.03 or 0.04 gram (½ to ⅔ grain) of the stronger salts (bichloride and cyanide) and of 0.06 to 0.08 gram (1 to 1¼ grains) of the weaker salts (benzoate or biniodide); he even considers likely in the future, for the treatment of parasyphilitic disturbances in particular, the use of doses still larger and agents still more powerful. It is difficult to formulate a definite conclusion as to whether such doses are warranted and harmless, but it may be stated at once that being exceptional, they can be applied only in quite exceptional cases, and that one should decide to take the risk of using such doses only when treatment with the usual doses has failed. It is quite certain, however, that in the matter of mercurial treatment, as in many others, one is apt to sin through timidity much oftener than through undue boldness.

INJECTIONS OF GRAY OIL.—As regards gray oil (oleum cinereum), one can accept the opinion of Brocq, of which Fournier has expressed

his authoritative approval: "An undeniable fact, and one which every practitioner should know, is that it [the treatment with gray oil] is now by far the most convenient procedure for treating syphilis in busy individuals, the careless, and those who wish to conceal their condition. In particular, it is the ideal procedure for the lower laboring class. We are thus enabled to treat effectively, safely and painlessly syphilitics who without this measure would treat themselves only incompletely or not at all. It is the common form of treatment for syphilis in workmen and in constantly busy persons."

It should be carefully borne in mind, however, that this proceeding rather often gives rise to manifestations of poisoning, to diarrhea, to erythematous rashes and, in particular, to stomatitis, which conditions may appear six weeks or even longer after the last injection. Numerous fatal cases have been recorded.

Accordingly, gray oil injections should certainly be avoided where the kidneys or mouth are diseased or if varicose veins are too pronounced. In new patients, whose tolerance of mercury is not known, one should begin cautiously with a very small dose of gray oil, *e.g.*, one containing 0.01 to 0.02 gram (1/6 to 1/3 grain) of mercury. [Gray oil is a 40 per cent. suspension of metallic mercury in oil.] Further, gray oil is contraindicated in the aged, in cachectic or debilitated individuals, in alcoholics, in arteriosclerotics, in the gouty, in the tuberculous, and in pregnancy with albuminuria (Duhot).

It is very necessary to carry out the injection in two stages in order to be sure that the needle has not entered a vein.

Gray oil of the strength generally used is too concentrated a preparation, as a 40 per cent. oil can be injected only with a special syringe. Use of the ordinary hypodermic syringe introduces an element of risk, as the introduction of markedly excessive doses may result. It is better to use a 10 or 20 per cent. oil, which will prevent the grosser errors. It is also well to weigh exactly the mercury that is to go into any given amount of the preparation to be employed.

As an excipient, Lafay, who is expert in this connection, has proposed the following combination:

Anhydrous lanolin, pure and sterilized,
White vaselin ....of each 10 grams (ʒiiss);
Liquid petrolatum, sterilized .... 30 grams (f℥j).

Thus, to obtain gray oil containing, for instance, 0.1 gram (1½ grains) of mercury per cubic centimeter, one might write:

℞ Hydrargyri .... 2 grams (ʒss);
Adipis lanæ anhydrosi puri et sterilisati,
Petrolati albi ....āā 4 grams (ʒj)
Petrolati liquidi sterilisati ....q. s. ad 20 c.c. (fʒv). —M.

At all events, it is best to use only gray oil of reliable manufacture and which has been thoroughly tried out.

The question of dosage and of the frequency of injection has been and is still being much discussed. On the whole, and disregarding many obscure features, it would appear that most syphilographers consider as average active doses for adults 0.05 to 0.15 gram (¾ to 2½ grains) of metallic mercury, or, as the most commonly used amounts, 0.08 to 0.09 gram (1¼ to 1⅖ grains) in males and 0.06 to 0.07 gram (⁹⁄₁₀ to 1¹⁄₁₀ grains) in females. Such injections, in the course of really active antisyphilitic treatment, should be given, on an average, at weekly intervals. Four to six weekly injections, according to the individual case, should be administered. This, it will be seen, corresponds to about 0.01 gram (⅙ grain) a day.

For information as to the actual procedure in the injection of the soluble or insoluble salts and the manner of administering subcutaneous, intramuscular or intravenous injections, the reader is referred to the section on *Therapeutic Procedures.*

Mercurial Inunctions.—The two preparations commonly used for this purpose in France are the gray ointment or simple mercurial ointment and the stronger (double) mercurial ointment or Neapolitan ointment, the official (Codex) formulas of which are as follows:

Neapolitan ointment.

Metallic mercury	500 grams (℥xvʒv);
Benzoinated lard	460 grams (℥xivʒiij);
White wax	40 grams (ʒx).

Gray ointment.

Stronger mercurial ointment	100 grams (℥iij);
Benzoinated lard	300 grams (℥ix).

The first of these preparations is to be preferred, and is used in average doses of 4 to 8 grams (1 to 2 drams). It is convenient to have the ointment put up in separate 2-gram papers, the dosage being thus readily adjusted by the patient.

[The corresponding U. S. P. preparations are *Unguentum hydrargyri fortius,* a mixture of mercury, 50 parts; oleate of mercury, 2; prepared suet, 23, and benzoinated lard, to make 100, and *Unguentum hydrargyri mite,* a mixture of the preceding preparation, 60 parts, and petrolatum and ointment, 20 parts of each. The former yields approximately 50 and the latter 30 per cent. of mercury. A dilution of the stronger ointment with hydrous-wool fat may be preferred to the official mild ointment.]

The inunctions should be carried out as follows: The prescribed amount of ointment is spread over the area selected for the inunction,

rubbed in lightly for about ten minutes with cotton or flannel, or better directly with the hand, the area then covered with cotton, and the latter held in place with a handkerchief or a few turns of bandage. Next morning the area is to be carefully washed with soap. [According to Cole, Gericke and Sollmann, the residue of ointment after 30 minutes' rubbing can without disadvantage be removed at once by the free use of benzine and cotton.]

The areas of election for inunctions are: The lateral aspect of the trunk, the bend of the elbow, the inner aspect of the thigh, the inguinal region, and the calf of the leg. It is recommended not to repeat the inunction in the same area on successive days:

Miscellaneous Routes of Mercurial Administration:

RECTAL ROUTE:

℞ Unguenti hydrargyri fortioris .... 0.03-0.09 gram (gr. ss-iss);
Olei theobromatis .... 3 grams (gr. xlv).
Ft. suppos. No. i. Da tal. No. xx.
Sig.: One suppository to be inserted on retiring.

A very convenient and discreet procedure, which can be warmly recommended.

SUBPREPUTIAL ROUTE:

℞ Unguenti hydrargyri fortioris .... 0.02-0.08 gram (gr. ⅓-i¼);
Olei theobromatis .... q. s.

This is to be made into a small wafer of the size of a lentil, to be inserted between the glans and the prepuce (MILIAN).

It is the treatment of choice in *syphilids of the penis.*

VAGINAL ROUTE:

℞ Unguenti hydrargyri fortioris .... 0.1 gram (gr. iss);
Olei theobromatis .... 0.4 gram (gr. vj).

This is to be made into a rounded vaginal suppository, of which 20 may appropriately be ordered.

The patient introduces one suppository into the vagina on retiring and inserts against it a tampon of absorbent cotton to prevent escape of the fused material. The suppository is to be renewed each night, but it is well for the patient not to take an injection oftener than every two or three days.

MERCURY IN CHILDREN.—In congenital syphilis in *breast-fed infants,* a 1:1000 solution of mercury bichloride in distilled water or in a 10 per cent. mixture of alcohol and distilled water (Van Swieten's solution) may be given in a daily dosage of 10 drops per month of age, divided into 5 fractional amounts given in milk just before the

child is put to the breast. The dose per year of age is 2 c.c. (32 minims).

After the third month, Gibert's syrup (see below) may be given instead to the amount of one-third teaspoonful, to be taken in 3 doses in the 24 hours. Thus, 4 c.c. (60 minims) of this syrup might be prescribed with 5 drops of paregoric and 40 c.c. (10 fluidrams) of some simple infusion, and 1 teaspoonful of the resulting preparation be ordered taken in 1 teaspoonful doses three times daily just before the feedings. Comby gives the dose of Gibert's syrup in congenital syphilis as ½ teaspoonful a day per year of the child's age.

If one is apprehensive of digestive disturbances from oral administration, preference might be given to *mercurial inunctions* in ascending daily doses of 0.5 to 1 gram (7½ to 15 grains) or even 2 grams (30 grains), according to tolerance. The areas of election would be: The axillæ, the popliteal regions, and the surfaces over the kidneys, liver and spleen. The ointment should be left *in situ* for 12 hours, then washed off carefully with soap to obviate skin irritation. These inunctions are very effective in infancy and never induce salivation.

The mercurial treatment should be continued daily for three months; in the fourth month, ten days' rest should be allowed; in the fifth month, fifteen days; then the treatment should be left off for a month or two (unless symptoms appear).

Above the age of two years, the 1 in 1000 bichloride solution should be given one month out of every three in ascending daily doses of 60 to 100 drops; Gibert's syrup, in ascending daily doses of ½ to 2 teaspoonfuls, and mercurial ointment, in doses of 1 to 2 grams (15 to 30 grains). Potassium iodide should also be administered one month out of every three in daily amounts of 0.2 gram (3 grains).

In the third year, the inunctions should be continued one month out of every three, and the daily dose of iodide raised to 0.4 gram (6 grains).

In the fourth year, the iodide should be given only one month out of every four in daily doses of 0.5 gram (7½ grains).

In the fifth year, the treatment may, unless relapse occurs, be considered terminated. It will be wise, however, to have another course of treatment carried out annually from the eighth to the sixteenth year.

COMBINATIONS WITH MERCURY.

I. Specific Synergists.

(*a*) Iodine and Mercury.

GIBERT'S SYRUP:

℞ Hydrargyri iodidi rubri	0.5	gram	(gr. viiss);
Potassii iodidi	25	grams	(ʒviss);
Aquæ	25	c.c.	(fʒviss);
Syrupi	750	c.c.	(f℥xxv). —M.

Each tablespoonful of this syrup contains about 0.01 gram (1/6 grain) of mercury biniodide and 0.5 gram (7½ grains) of potassium iodide. It is prescribed in daily doses of 2 to 4 tablespoonfuls, to be taken at the beginning of the meals, between 2 tablespoonfuls of soup or of milk.

GIBERT'S SYRUP (as modified by VIDAL):

℞ Hydrargyri iodidi rubri	0.15	gram	(gr. iiss);
Potassii iodidi	15	grams	(℥ss);
Syrupi cinchonæ (Codex)	375	c.c.	(f℥xiiss).

Ft. sec. art. Non filtr.

Each tablespoonful of this contains about 0.006 gram (1/10 grain) of mercury biniodide and 0.6 gram (9 grains) of potassium iodide. The preparation is used in the same doses as the preceding one, *viz.*, 2 to 4 tablespoonfuls a day *or more* at the beginning of the meals.

There is now an increasing tendency to discard these mixed preparations and substitute for them separate administrations of the iodide and mercury, which plan is much less unpleasant and much better borne by the stomach and permits of the giving of much larger amounts of the two drugs. Thus, the mercury may be prescribed by inunction—a procedure which seems to be coming back into favor after temporary unpopularity—or by hypodermic injection, while the potassium iodide is given by the mouth.

(*b*) ARSENIC AND MERCURY:

Ricord already made use of this combination in prescribing DONOVAN'S SOLUTION:

℞ Arseni iodidi	0.2	gram	(gr. iij);
Hydrargyri iodidi rubri	0.4	gram	(gr. vj);
Potassii iodidi	4	grams	(ʒj);
Aquæ destillatæ	125	c.c.	(f℥iv).

M. Sig.: Sixty to 100 drops a day.

[The U. S. P. *Liquor arseni et hydrargyri iodidi* contains 1 per cent. each of arsenous iodide and mercury biniodide. Dose, 0.1 c.c. (1½ minims).]

The combination of these drugs may also be availed of:

Either by the *administration of a compound of arsenic and mercury,* such as mercury salicylarsenate (enesol), injected in doses of 0.06 to 0.09 gram (1 to 1½ grains), or hectargyre (hectine and mercury),

used in doses containing 0.1 to 0.2 gram (1½ to 3 grains) of hectine and 0.005 to 0.01 gram (1/12 to 1/6 grain) of mercury;

Or by the *conjoint administration* of a mercury compound (pills, solution, inunction or injection) and an arsenic compound (granules, solution or injection);

Or by *alternate administration* of an arsenical product (arsphenamin, sodium cacodylate, galyl, hectine, etc.) and a mercurial product—in short, by alternating mercurial and arsenical courses of treatment.

II. **Corrective Combinations.**—In cases in which there is reason to be apprehensive of a diarrheal action—which is very common in mercurial treatment—the mercury can be combined with an antidiarrheic corrective such as cinchona, opium or krameria.

Thus, one might prescribe:

℞ Hydrargyri iodidi rubri .... 0.15 gram (gr. iss);
Potassii iodidi .... 15 grams (℥ss);
Syrupi cinchonæ (Codex) .... 375 c.c. (f℥xiiss).
M. Sig.: One to four tablespoonfuls a day in the secondary stage of syphilis.

Or:

℞ Hydrargyri chloridi corrosivi,
Extracti opii .... āā 0.1 gram (gr. iss);
Glycerini .... q. s.
Ft. pil. No. i. Da tal. No. xxx.
Sig.: Two to four pills a day, according to tolerance.

Or, again:

℞ Hydrargyri iodidi flavi,
Extracti krameriæ, N. F.,
Extracti cinchonæ, N. F. IV .... āā 0.05 gram (gr. ¾);
Glycerini .... q. s.
Ft. pil. No. i. Da tal. No. xxx.
Sig.: Two to four pills a day, according to tolerance.

TOXIC EFFECTS OF MERCURY.—Even the most cleverly devised combinations cannot, however, entirely do away with toxic mercurial effects, with which the practitioner should be thoroughly familiar so that he may be able to detect, care for and relieve them.

The commonest of these are the *gastrointestinal effects*—actual *local disturbances* which mainly follow oral administration of mercury and appear to be induced by the direct irritant action exerted by the mercurial preparations when brought in contact with the mucous membrane of the digestive tract. They are chiefly manifested in gastralgia, cramps, diarrhea, vomiting and, in the long run, chronic gastritis.

In this connection the preparations of mercury can, it would seem, be arranged in the following order: Mercury tannate, protiodide, biniodide, and bichloride, Van Swieten's solution, and Gibert's syrup. This accounts for the favor enjoyed by the protiodide and the bin-

iodide among syphilographers. Further, I have already pointed out above how certain combinations were capable of reducing the frequency and severity of these toxic manifestations.

More important are the *effects related to mercury intoxication,* these being *general effects* which are common to all modes of administration of mercury, and in the front rank of which must be placed **stomatitis.**

At present one hardly sees any more the malignant forms of stomatitis with ulcerations, gangrene, falling out of the teeth and necroses, the whole constituting the most salient result of the excessively intensive mercury courses of earlier periods; one still sometimes observes, however, especially in patients whose jaw has been neglected, a mercurial stomatitis of varying intensity, beginning oftenest in the lower median incisors, on the lateral aspects at the level of diseased teeth and behind the last molar. The best procedures that may be tried to prevent it will be described further on.

Next to stomatitis, the **mercurial skin eruptions** are most frequently observed. Three forms are described:

1. *Hydrargyria mitis,* the mild form, characterized by an erythema, sometimes accompanied by miliaria, situated on the abdomen, in the groins, on the inner aspects of the thighs, and in the vicinity of the large joints; it is accompanied by local burning and ends in slight desquamation.

2. *Hydrargyria febrilis,* a form of intermediate severity characterized by a distinctly scarlatinoid, local or generalized erythema, with more or less pronounced constitutional symptoms (fever, chills, diarrhea, albuminuria); the erythematous surface may, as in the preceding form, become covered with vesicles, or even with pustules; desquamation takes place in sheets, as in scarlet fever; its duration varies markedly, averaging ten to fifteen days, but in a few cases extending to eighty days.

3. *Hydrargyria maligna,* the malignant form, with an almost purpuric scarlatinoid eruption, with purulent and blood-filled bullæ, adenitis, abscesses, gangrenous ulcerations and intense general manifestations (fever, diarrhea, albuminuria, etc.). Death has been observed in a few instances.

Mercury has a special affinity for the kidney cells, and these organs are among those most rapidly and frequently involved in mercurial poisoning. Mercurial nephritis is primarily a tubular nephritis; a capsular glomerulo-nephritis with exudation is equally common. In carrying out intensive mercurial treatment the condition of the kidneys and the urine should, therefore, be carefully investigated.

Injections of calomel seem to induce skin manifestations more frequently than the other salts of mercury and the other methods of mercury administration. Accordingly it is advisable, in cases in which this form of administration is deemed indispensable, to consider 0.03 gram (½ grain) as the maximum initial dose and 0.05 gram (¾ grain) as the absolute maximum dose.

In referring to the injection of mercurial compounds, the *possibility of local manifestations due to such injections* (pain, abscesses, sloughs, etc.) was mentioned. To these may be added the serious cerebral complications observed following injections of the insoluble salts, and pulmonary embolism, which, it seems possible, may be avoided by discarding oily menstrua and by making sure, before carrying out the injection, that the needle has not been introduced into a vein.

To reduce to a minimum the probability of mercurial toxic manifestations in a patient under treatment, the following precautions should be observed:

1. *The condition of the mouth should be investigated,* and if the occasion exists (dental caries, snags, tartar, etc.), the patient sent before starting any treatment to a dentist for a *careful cleaning up of the jaw and its appendages.*

Regular care of the mouth should be required of the patient, including careful and prolonged brushing of the teeth, cleansing with tooth paste, and rinsing with an alkaline solution containing potassium chlorate; a 2 per cent. solution of the chlorate should be used thus morning and evening and after each meal.

2. *The digestive tract should be carefully examined* (dyspepsia, gastralgia, enteritis, diarrhea or constipation) in order that it may be placed in good condition previous to any treatment; or a special mode of administration of the mercury (inunction, injections) chosen, or the required corrective medication availed of (addition of cinchona, opium or krameria; intestinal antisepsis) in patients with a tendency to diarrhea.

The preparations of mercury should be ordered taken at the beginning of the meals, or with a large cupful of milk—never on an empty stomach.

3. *The condition of the kidneys should be investigated,* especially if intensive and prolonged treatment is in order.

4. The preparation of mercury used should be *varied* during the course of the treatment. In the event of failure or of insufficient action, one should make certain that the patient is actually taking the dose prescribed and that the preparation (especially in the case of pills) is well made and absorbable. The dose should be increased

only after investigation in these directions, and if lack of success continues, the preparation used should be rapidly changed, inunction being substituted for oral administration, injections for inunction, etc.

5. Finally, one should always keep in mind those idiosyncrasies in which the subject shows an extraordinary susceptibility to some drug or other. Mercury is among these, as illustrated in a case I have recorded (*Presse méd.,* July 8, 1905) in which a woman developed serious toxic mercurial manifestations following the filling of teeth, in the course of which at most 0.02 gram (1/3 grain) of mercury had been employed. Consequently it is well to be particularly *cautious in the administration of mercury in a subject whose tolerance is as yet unknown.*

Is prolonged administration of mercury, or are large doses of it, capable of causing deep-seated injury to the organism, of inducing incurable degenerative changes, and in particular of bringing on the major parasyphilitic nervous involvements (tabes, pseudo-tabes, general paralysis), as a few German neuropathologists have maintained? This is hardly probable, and in this connection the statistics of Fournier *seem* to be sufficiently conclusive.

Nevertheless, Brocq (*Jour. de méd. et de chir. prat.,* Oct. 10, 1906) has witnessed in a few patients the development of nervous phenomena similar to those of general paralysis as soon as certain doses were exceeded; in others there were produced lightning pains in the extremities and violent headache as soon as rather large doses were reached, so that such patients could be suspected of being paretics or tabetics; all of these manifestations disappeared when the mercurial treatment was stopped and later reappeared upon return to the large doses. Manifestations of an entirely different sort are also seen; thus, Brocq has seen nodular swellings similar to gummas on the forehead, tibia, etc., which lesions increased in size as the dosage of mercury was pushed, and disappeared when it was reduced. It is well to keep these clinical observations in mind; the mere recollection of them will suffice at times to avoid a catastrophe.

In moderate though sufficient doses, mercury in cases of active syphilis exerts, on the other hand, a stimulating action on nutrition and oxygenation, and in particular causes a rise in the number of corpuscles and the hemoglobin percentage (this property is common to it and the other heavy metals, in particular iron and copper).

II.—ANTIMALARIAL AGENTS.

QUININE AND CINCHONA.

QUININE. Extracted from *Cinchona* (Rubiaceæ).—While regarded as the specific for malaria, quinine possesses a very complex action. This shows us once again that, in chemotherapy especially, there exist but few (or even no) substances having a strict specificity.

Antipyretic Action.—The antipyretic action depends, on the one hand, on the *antiseptic action* and on the other, on the *inhibitory action* on the processes of cellular oxidation. The number of calories set free by a living organism in a given period of time is, in the last analysis, but the sum of calories set free in the processes of cellular oxidation, and consequently the internal temperature of the organism, dependent upon this aggregate liberation of calories, will obviously be influenced by any substance capable of slowing the oxidation processes; this is the case with quinine. The question is, however, more complex than this, and a number of factors may and must intervene in this antipyretic action (*antiseptic action; action on the circulation; action on the heat-regulating centers,* and *inhibiting action on the sympathetic system*).

In the normal individual quinine exerts practically no antipyretic action.

In febrile states, the antipyretic action varies with the dose and the disease present. It is practically wanting in typhoid fever, but very marked in malaria.

Whatever be the truth as to the exact mode of production of these fundamental effects of quinine, *viz.*, its antiseptic and antipyretic actions, it has seemed to me of interest to try to account for them by a more deep-seated action, such as a slowing of the processes of oxidation; an inhibiting action on the sympathetic system—a probable though as yet hypothetic action, yielding useful therapeutic deductions, and which harmonizes very well with, if indeed it does not explain, the secondary actions, still to be mentioned.

A marked influence is exerted on the central nervous system by quinine, particularly in the normal subject. According to the dose and the time of administration, there is noticed first a *stage of excitation,* manifested in dizziness, restlessness, tinnitus aurium, visual hallucinations and exaggerated reflexes, and probably dependent upon some degree of hyperemia of the brain and spinal cord, followed by a *stage of depression* characterized by apathy, quietude, sleep, and diminution of sensibility and of the reflexes.

The **disturbances of cardiac conductivity** caused by quinine, which have been clearly demonstrated by Clerc and Pezzi, have supplied some

interesting therapeutic indications in the **treatment of the arhythmias.** Following are the results which now appear to be well established.

1. **Quinidine** (dextrorotatory optical isomer of quinine) frequently proves effective in auricular fibrillation.

2. The results, however, are uncertain (50 per cent. of successful results, according to the records of Clerc and Deschamps).

3. The benefit is transient in the majority of cases.

4. The depressant action on the myocardium referred to by all the older authors has been confirmed by most of the recent observers.

5. While the question of dosage is not yet entirely settled, the dosage employed by Clerc, Deschamps and Wybauw seems to be the most reasonable: Increasing doses of quinidine for three to five days, without exceeding 1.25 to 1.5 grams (19 to 23 grains) *per diem.*

6. Some serious accidents during treatment have been reported.

Nonetheless the procedure is an interesting one, sometimes impressive in its results, but it cannot be considered quite free of risk.

7. Although the question is not as yet definitely settled, quinidine seems to be more active than its isomer, quinine.

There remain to be mentioned:

1. A possible action in **exciting contraction of smooth muscle,** which the obstetricians (including Tarnier) recognize, in the absence, however, of any experimental proof. This action is still *sub judice.*

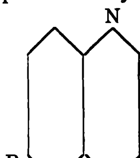
2. A **stimulant action** on the **salivary and gastric secretions,** which quinine possesses in common with the other "bitters."

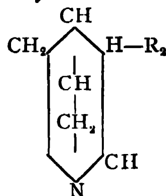
Chemical Composition.—Referring only to the crystalline alkaloids (alone recognized as active up to this time) which are extracted from cinchona bark, we may group these in two principal series:

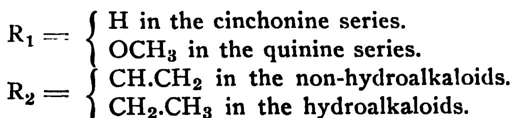
(*a*) Cinchonine series, including cinchonidine and hydrocinchonine.

(*b*) Methoxycinchonine or quinine series, including quinidine, hydroquinine, and its isomer, hydroquinine.

These compounds may be represented by the following diagrams:







$R_1 = \begin{cases} \text{H in the cinchonine series.} \\ \text{OCH}_3 \text{ in the quinine series.} \end{cases}$

$R_2 = \begin{cases} \text{CH.CH}_2 \text{ in the non-hydroalkaloids.} \\ \text{CH}_2\text{.CH}_3 \text{ in the hydroalkaloids.} \end{cases}$

In a general way, recent investigations seem to show that:

The levorotatory alkaloids (*quinine* and *hydroquinine*) exert a more pronounced specific action against the parasite of *malignant tertian* malaria.

The dextrorotary alkaloids (*quinidine*) exert a more powerful specific action against the parasite of *benign tertian* malaria.

* * *

Quinine in the Ordinary Febrile Diseases.—1. Quinine is considered practically a specific in **malaria.**

In order to obtain from quinine all of its useful effects on *malarial paroxysms,* it is important in administering it to adhere to the following easily applied rule, developed mainly through the labors of Treille and of Legrain: *Give the drug at the moment of temperature ascent, in the dose required by the type of fever present* (2.5 grams—40 grains—*in quotidian fever;* 2 grams—30 grains—*in tertian fever, and* 0.5 gram—7½ grains—*in quartan fever*). *The existing paroxysm runs its course unchanged; succeeding paroxysms are eliminated.*

In *pernicious malarial fever,* rapid and vigorous action is required; the quinine should, therefore, be given immediately and continuously, without paying too much attention to the foregoing rules. In these cases preference should be given to the intravenous route, the action of which is unquestionably more rapid.

In *malarial cachexia,* quinine may render distinct service, but iron, arsenic and hydrotherapy should be combined with it.

2. In **typhoid fever,** the utility of quinine is a moot point; at all events, it is preferable to the depressant antipyretics, antipyrin, acetphenetidin, pyramidon, etc.

3. In spite of its inconstancy and uncertainty of action, quinine may be used symptomatically as an antipyretic in **febrile disorders** such as influenza, erysipelas, the eruptive fevers, pneumonia, septicemia, purulent infections, puerperal sepsis, etc.

Quinine in Hemorrhage.—Quinine may be of undoubted service in various forms of hemorrhage, *e.g.,* in *obstinate epistaxis, dental hemorrhage, tuberculous hemoptysis with fever, metrorrhagia refractory to ergot,* and *metrorrhagia of the menopause.*

Quinine has also been recommended:

In *exophthalmic goiter* (large doses, 1 to 2 grams—15 to 30 grains—or more).

In *Ménière's disease,* by Charcot (caution, however, according to Lermoyez).

In some cases of *aortic insufficiency of the Corrigan type,* by Huchard.

. In the *vasomotor disturbances of herpetism,* by Lancereaux.

In *malignant tumors* that are non-operable, or after operation, by Jaboulay and Launois.

In *auricular fibrillation.*

MODES OF ADMINISTRATION.

Dosage: In children, 0.1 gram (1½ grains) of quinine sulphate per year of age; in adults, 0.5 to 3 grams (7½ to 45 grains).

For practical purposes, a dose of quinine dihydrochloride is equivalent to double the amount of quinine sulphate.

Quinine Salts.—In the order of *decreasing* percentage of alkaloidal quinine, the salts appear as follows: Hydrochloride, hydrobromide, sulphate, dihydrochloride, bisulphate.

In the order of *increasing* solubility: Sulphate, 1:580; hydrobromide, 1:45; hydrochloride, 1:23; bisulphate, 1:11; dihydrochloride, 1:0.6.

[Quinine and urea hydrochloride ranks with the salts of lower quinine content and its solubility is 1:1.]

From the standpoint of solubility in particular, preference may be given to the dihydrochloride.

There is always advantage in having the drug ingested with a slightly acid beverage, such as lemonade.

Cachets:

℞ Quininæ dihydrochloridi .... 0.5 gram (gr. viiss).
Pone in cachet. No. i. Da tal. No. xxx.
Sig.: One to four cachets a day (according to indications).

Tablets can be similarly prescribed.

Capsules each containing 0.05, 0.1 or 0.25 gram (¾, 1½ or 4 grains) may likewise be ordered.

℞ Quinidinæ sulphatis .... 0.2 gram (gr. iij).
Pone in cachet. vel tabell. No. i. Da tal. No. xl.
Sig.: Three to six (or more) a day, according to effect and tolerance (in *auricular fibrillation*).

The markedly bitter flavor of quinine makes its administration in a liquid preparation difficult, especially in children. One may, if necessary, try the following *corrective formulas* advocated by Comby:

(1) ℞ Quininæ dihydrochloridi .... 0.3 gram (gr. v);
Extracti glycyrrhizæ .... 5 grams (gr. lxxv);
Syrupi aurantii florum .... 15 c.c. (f℥ss);
Aquæ destillatæ .... 40 c.c. (fℨx).
M. Sig.: To be taken in two or three swallows.

(2) ℞ Quininæ hydrochloridi .... 2 grams (ℨss);
Glusidi .... 0.3 gram (gr. v);
Tincturæ aurantii amari .... 5 c.c. (♏ lxxx);
Syrupi .... 45 c.c. (f℥iss).—M.

One dessertspoonful of the above preparation contains about 0.3 gram (5 grains) of the quinine salt.

(3) ℞	Quininæ hydrochloridi	1 gram	(gr. xv);
	Glusidi	0.3 gram	(gr. v);
	Syrupi caffeæ	15 c.c.	(f℥ss);
	Aquæ	10 c.c.	(fʒiiss).—M.

One teaspoonful of the above preparation contains about 0.15 gram (2½ grains) of the quinine salt.

Testing the urine for quinine is sometimes very serviceable, especially in military practice, in order to make sure that the quinine prescribed has actually been taken. The test can be simply performed as follows:

1. Have the patient urinate under observation at the moment of beginning the test.

2. Place 2 c.c. of the urine in a test-tube and add a few drops of Tanret's reagent [KI, 3.32 grams; $HgCl_2$, 1.35 grams; acetic acid, 20 c.c.; distilled water, to make 64 c.c.].

3. If the urine contains quinine, it will at once exhibit an opalescent tint varying in intensity with the amount of quinine present.

4. Add a few drops of alcohol. The precipitate dissolves immediately; this differentiates it conclusively from the precipitate obtained with the same reagent in urine containing albumin.

5. This reaction, which is extremely sensitive, appears about two hours after the taking of quinine and persists at least twenty-four hours, even after only small amounts of the drug, such as 0.25 gram (4 grains), and up to forty-eight hours after doses of 1.5 to 2 grams (23 to 30 grains).

In whatever form quinine is administered, there is advantage in having it taken with some acid drink, such as lemonade or even a solution of hydrochloric acid. The reason for this is simple: The basic salts being far less soluble than the neutral salts, the solubility will be appreciably diminished in alkaline or feebly acid media and markedly increased in acid media. This fact is especially to be borne in mind in the administration of salts of low solubility such as the sulphate, for the quinine then seldom finds in the gastric juice enough acid to dissolve it, and a considerable part of the salt passes into the intestine, where, encountering an alkaline medium, it cannot dissolve, so that it passes through the body and passes out in the stools without having been absorbed. Lauder Brunton estimates that 0.5 gram (7½ grains), dissolved in a sufficient quantity of acidulated water, will exert a more marked effect than 1.5 gram (22½ grains) without the

acid. On the basis of these considerations Lindewurm formulated the following solution:

℞ Quininæ hydrochloridi .... 1 gram (gr. xv);
Acidi hydrochlorici .... 1 gram (♏xv);
Aquæ destillatæ .... 25 grams (f℥viss).

M. Sig.: To be taken at one dose in water, if necessary with addition of a little white wine.

Another factor that may have an important bearing on the absorption of quinine salts is the condition of the digestive tract. *Upset stomach or congestion of the liver markedly reduce the power of absorption of the digestive mucous membrane,* whence the formal indication of first of all decongesting the liver and alimentary canal with calomel or a brisk saline purge. This indication is particularly urgent in malaria, in which hepatic congestion is almost constantly present.

* * *

Where administration by the oral route is impossible or very difficult, as in children, and the hypodermic route is not specially indicated, the **rectal route** may be availed of.

An *enema*, to be retained by the child, may be ordered thus:

℞ Tincturæ opii crocatæ (N. F.) .... gtt. j;
Quininæ dihydrochloridi .... 0.2 gram (gr. iij);
Infusi anthemidis tepidi .... 100 c.c. (f℥iiiss). —M.

Its administration should be preceded by a copious cleansing enema.

The *suppository* is, however, preferable. This mode of administration is sharply criticized by Pouchet; there seems to be no doubt, however, that it is of appreciable service in pediatric practice.

℞ Quininæ dihydrochloridi .... 0.2 gram (gr. iij);
Olei theobromatis .... 1-2 grams (gr. xv-xxx).

Ft. suppos. No. i.

For children one may, furthermore, resort to the use of **quinine ethyl-carbonate (euquinine)**, an ethyl-carbonic ester of quinine, which is tasteless, insoluble in pure water, but soluble in acidulated water or water to which alcohol has been added. It is used in doses of 0.1 gram (1½ grains) per year of age.

℞ Quininæ æthylcarbonatis .... 0.15 gram (gr. iiss);
Sacchari .... 3 grams (gr. xlv).

Pone in chart. No. i. Da tal. No. x.
Sig.: To be taken in milk, soup or water to which alcohol has been added.

Hypodermic Injection of Quinine.—Upon encountering the graver manifestations of malaria, one must endeavor to act rapidly and energetically, and in this event, the hypodermic route is indicated.

In this connection there are important reasons for favoring the use of the *dihydrochloride*, which contains 81 per cent. of pure quinine and is so soluble in water that the latter will dissolve more than its own weight of the salt.

One may prescribe:

℞ Quininæ dihydrochloridi .... 5 grams (gr. lxxv);
Aquæ destillatæ ....q. s. ad 10 c.c. (f℥iiss). —S.

One cubic centimeter (15 minims) of this solution contains 0.5 gram (7½ grains) of the quinine salt.

Laveran has advocated the use of the *hydrochloride*, and as its solubility in water is only about 1:20, has circumvented the difficulty of obtaining a sufficiently concentrated solution by taking into account the fact that addition of antipyrin so increases its solubility that 1 gram (15 grains) of the hydrochloride, to which 0.5 gram (7½ grains) of antipyrin is added, will dissolve in 2 c.c. (32 minims) of distilled water. He therefore offered the following formula:

℞ Quininæ hydrochloridi .... 3 grams (gr. xlv);
Antipyrinæ .... 2 grams (gr. xxx);
Aquæ destillatæ .... 6 c.c. (f℥iss). —S.

In my estimation it is well to modify it thus:

℞ Quininæ hydrochloridi .... 3 grams (gr. xlv);
Antipyrinæ .... 2 grams (gr. xxx);
Aquæ destillatæ .... 10 c.c. (f℥iiss). —S.

One cubic centimeter (15 minims) of this solution contains exactly 0.3 gram (5 grains) of the quinine salt.

The ampules supplied by the French "Service de Santé" were of the following composition:

℞ Quininæ hydrochloridi .... 8 grams (℥ij);
Æthylis carbamatis .... 4 grams (℥j);
Aquæ destillatæ .... 20 c.c. (f℥v).
Solve cum leni calore.

One cubic centimeter (15 minims) of this solution corresponds to 0.4 gram (6 grains) of quinine hydrochloride. The solution keeps indefinitely.

The other salts of quinine should be used only as makeshifts: The sulphate has pronounced corrosive properties; the hydrobromide is less soluble than the hydrochloride and has a smaller content of quinine; the sulphovinate (ethylsulphate) is too unstable.

Only fresh solutions should be used, old solutions containing microscopic vegetable growths. The solutions should be of low concentration, overstrong solutions being capable of causing precipitation of the salt in the subcutaneous cellular tissue.

No antiseptic precaution should be neglected, including sterilization of the solution, syringe and site of injection.

Parts of the body where a thick, fatty panniculus underlies the skin should be selected—the outer aspect of the thigh, the buttock, the anterior aspect of the chest, etc.,—and the injection should be made into the deeper portions of the subcutaneous cellular tissue or intramuscularly.

In spite of all such precautions, it must be admitted that even in the hands of the most experienced, injections of quinine hydrochloride in weakened anemic, asthenic, cachectic patients—such as are most of the cases requiring these injections—have given rise to sloughing and abscesses with necrobiosis. This is a possibility which should always be kept in mind, and many articles have been appearing to remind us of the fact. It would appear that this mode of administration is destined to become less and less popular.

Intravenous Injection.—Intravenous injections are sometimes followed by serious untoward effects (weakened heart action, dyspnea, cyanosis) which may end fatally. Again, there remain, in certain cases, obliterations of the vein which make patients for a long time unable to return to their occupations. Accordingly, intravenous injections should be reserved for the serious and intractable cases. Baccelli has offered the following formula for intravenous injections:

℞ Quininæ hydrochloridi .... 0.75 gram (gr. xiss);
Sodii chloridi .... 1 gram (gr. xv);
Aquæ destillatæ .... 10 c.c. (f℥iiss).—S.

The addition of sodium chloride is superfluous, as a 7.5 per cent. solution of quinine hydrochloride is itself isotonic (P. Chapelle).

Paul Carnot prefers the following formula:

℞ Quininæ hydrochloridi .... 0.8 gram (gr. xij);
Æthylis carbamatis .... 0.3 gram (gr. v);
Aquæ destillatæ .... 20 c.c. (f℥v).
S. Sig.: For intravenous injection, to be administered slowly.

Finally, intravenous injections of *colloidal quinine* (quinine collobiase) have likewise been advocated.

From the standpoint of hypodermic administration, a marked advance was made in the introduction into therapeutics of *quinine formate* or quinoform. This salt is soluble in 19 parts of water at 15° C. and its aqueous solution does not decompose. It is the most soluble of the basic salts, and among all the quinine salts is the one containing the highest percentage of

alkaloidal quinine, *viz.*, 87 per cent. Its subcutaneous or intramuscular injection is generally painless.

A 5 per cent. solution of it may be ordered and injected in doses of 2 to 5 c.c. (32 to 80 minims) or more, according to indications.

COMBINATIONS WITH QUININE.

1. QUININE AND ANTIPYRIN.

This combination enormously increases the solubility of the quinine salts. It combines the antipyretic action of quinine with the antineuralgic action of antipyrin. Antipyrin lowers the reflex irritability of the nervous system and from this fact acts in some degree as a hypnotic.

(*a*) ℞ Quininæ hydrochloridi .... 3 grams (gr. xlv);
Antipyrinæ .... 2 grams (gr. xxx);
Aquæ destillatæ .... 10 c.c. (f℥iiss).
S. et sterilisa.
Sig.: For hypodermic injections.

In *febrile states with neuralgia and sleeplessness* I willingly prescribe the following cachets:

(*b*) ℞ Exalgin .... 0.1 gram (gr. iss);
Acetphenetidini .... 0.2 gram (gr. iij);
Antipyrinæ .... 0.3 gram (gr. ivss);
Quininæ hydrobromidi .... 0.4 gram (gr. vj).
Pone in cachet. No. i.
Sig.: To be taken at 3 P.M. with a cupful of some hot infusion.

(*c*) ℞ Antipyrinæ .... 0.2 gram (gr. iij);
Quininæ hydrobromidi .... 0.3 gram (gr. ivss);
Olei theobromatis .... 3 grams (gr. xlv).
Ft. suppos. No. i.

2. QUININE AND ARSENIC in *malaria* (see *Malaria*).

3. QUININE AND OPIUM in *rebellious neuralgias.*

℞ Extracti opii .... 0.025 gram (gr. 2/5);
Quininæ hydrobromidi .... 0.25 gram (gr. iv).
Ft. pil. vel cachet. No. i. Da tal. No. xii.
Sig.: Four pills (or cachets) a day; that is, one every three hours.

In the same type of case quinine might be combined with *aconitine:*

℞ Aconitinæ (cristallisatæ) .... 0.0001 gram (gr. 1/650);
Quininæ hydrobromidi .... 0.25 gram (gr. iv).
Ft. pil. No. i. Da tal. No. xx.
Sig.: Four pills a day at three-hour intervals.

MEDICINAL ADJUNCTS.—In conclusion, various drugs that may be used as adjuncts of quinine, *e.g.*, in *malarial fever,* should be mentioned. In *algid attacks,* ether, ammonium acetate, diffusible stimulants and hot drinks are definitely indicated; in *comatose attacks,* local blood-lettings and counterirritants; in attacks with *delirium,* chloral hydrate; in *bilious*

fever, ipecac and calomel, and in the *afebrile periods* of the disease, tonic medication with arsenic and iron has much to recommend it.

We may recall that quinine, in common with the other alkaloids, cannot be prescribed with tannic acid, which precipitates it from its solutions; one should therefore not be tempted to select, as I have seen it done, syrup of iodotannin as a vehicle for quinine.

UNTOWARD EFFECTS OF QUININE.—Administration of quinine at times causes unpleasant symptoms, with which the practitioner should be familiar. The commonest of these is a **ringing in the ears,** recalling somewhat the tinkling of bells and accompanied almost always by **hardness of hearing** and **heaviness of the head,** all manifestations apparently connected with some degree of brain congestion, albeit temporary, as they pass off after a few hours, as a rule completely. It even appears that these manifestations are altogether normal, and that they may in a measure serve for control purposes. When they fail to occur, one should carefully inquire: (1) Whether the patient has actually taken the dose prescribed; (2) whether the product delivered was the quinine salt ordered; (3) whether the dose was taken in the manner specified (with a certain amount of acid beverage).

The aural manifestations may become abnormal in their intensity; thus, there may be observed very severe **vertigo,** comparable with that of Ménière's disease. One should ascertain whether the dose given was too large; if not, a careful examination of the internal ear should be made, for according to Lermoyez, "everything depends on the condition of the labyrinth, and if there is the least lesion of this structure, the smallest dose of the drug will be sufficient to bring on manifestations of vertigo."

Another symptom which is frequent, though little mentioned in the standard books, is **bladder irritation,** manifested in frequent urination. This is especially pronounced in persons with irritable bladders, *e.g.,* the aged.

The **hemoglobinuria** following the use of quinine is observed only in malarial cases, the prejudicial effect of quinine in this direction requiring for its manifestations some previous change, possibly dependent upon the condition of the red blood cells which malaria brings about.

It has been said that quinine induces **contractions of the uterus** and expulsion of the fetus in pregnant women; we have already seen what one is justified in believing in this connection.

Sometimes gastric intolerance of quinine is manifested in **vomiting.**

More exceptionally there are noted during the process of elimination **skin manifestations** characterized by itching, sometimes intolerable, and even definite eruptions—erythematous, papular, urticarial, etc.

Here, however, we are entering the field of quinine **idiosyncrasy,** concerning which a few words should be said.

In some individuals, even the most trifling amounts of quinine are sufficient to bring on actual symptoms, of which the commonest are the *skin disturbances,* often assuming the appearance of an itching morbilliform eruption or an acute scarlatinoid exfoliative dermatitis, sometimes hemorrhagic.

In others there is observed, independently of the foregoing manifestations, a **general weakness** which may extend to paraplegia, clouding of the special senses, and precordial discomfort with a frequent, small pulse.

Finally, in still more severe cases, *profound collapse* has been witnessed, sometimes preceded by convulsions with inertia, insensibility, coldness of the extremities in spite of a normal temperature, cyanosis of the lips, pulse acceleration (100 to 120), and temporary cessation of urinary secretion. According to Guinon, however, the two most characteristic and constant evidences are: Complete, *abrupt deafness,* setting in in a few hours, and *total blindness* with abolition of the pupillary reaction of accommodation to light, due to the toxic action on the ganglion cells. The average duration of these symptoms is about two weeks.

In a recent study on **quinine amaurosis,** Ballantyne reached the following conclusions:

1. Poisoning with quinine may cause complete blindness without any change in the ophthalmoscopic picture, and vision may return in spite of obvious changes in the fundus.

2. In quinine amaurosis, congestion or pallor of the pupil, contraction of the vessels, and the retinal disturbance are more or less early symptoms, which are not constantly related, however, to the impairment of vision.

3. The visual disturbance must, therefore, be due to retinal disturbances which escape the ophthalmoscope.

4. That this disturbance may sometimes be caused or aggravated by ischemia of the retina is a possibility, but primarily it appears that one is dealing with a toxic action on the retina itself, and the hemeralopia seems to point to a selective action on the rods.

As a rule, these manifestations pass off under symptomatic medication, as by purgatives, stimulants (caffeine, etc.), and diuretics.

TREATMENT OF QUININE ABSCESSES.—Notwithstanding the progress made in the preparation of quinine salts and the precautions taken in the aseptic execution of the injections themselves, quinine abscesses are still frequently met with in military practice.

Now, the abdominal, gluteal or femoral quinine abscess is, by reason of the accompanying necrotic process and the extensive treatment it requires, a pathologic condition which cannot safely be overlooked.

Characterized clinically by slowness of incubation, by the progressive course of the lesions, by a painlessness and apyrexia which continue throughout the course of the disturbance, and by the absence of grave constitutional symptoms, the quinine abscess manifests itself pathologically, on the other hand, by serious necrotic and gangrenous lesions. There occurs first a rapid necrobiotic process of the subcutaneous cellular tissues, then fascial lesions, and finally involvement of the muscle tissue. Purulent disorganization of these several tissues takes place in the following order: Sloughing of the fasciæ and cellular tissues, sloughing of the muscles, then sloughing of the skin. In view of the rapid progression of the necrosis, it will readily be understood that treatment with small openings and sparing drainage is generally ineffectual.

The most reliable plan of treatment consists in making early, long and deep incisions, extending beyond the necrotic focus in all directions. All dead tissue should be excised, the tissue layers separated from end to end, necrotic tissues and pus evacuated from all recesses, numerous openings made to expose all foci of suppuration, and the wound cleansed, dried and drained with aseptic absorbent gauze. This was the method employed by Prat-Flottes and Violle, who had reason to be gratified by the uniformly excellent results of their 46 extensive operative interventions in such cases, for the most part requiring general anesthesia.

CINCHONA.

Quinine has cast cinchona into the shade, as digitalin has likewise [in France] overshadowed digitalis. Herein lies an error and an injustice—which, indeed, are often identical. Quinine is no more cinchona than digitalin is digitalis. While superior to cinchona in its antipyretic and antimalarial properties (especially in the acute and subacute stages), quinine possesses neither the tonic, the stomachic, nor the astringent properties of cinchona. The latter overtops quinine in chronic conditions associated with weakness, anemia,

anorexia and impaired nutrition. Many clinicians have deemed it superior to quinine in the course of the asthenic forms of influenza met with in epidemics.

It may be prescribed:

In a *powder*, as such, *i.e.*, as powdered cinchona bark, in cachets—1 to 6 grams (15 to 90 grains) a day—which, however, are sometimes poorly borne by the stomach.

In a *fluidextract* [*Fluidextractum cinchonæ*, U. S. P.], representing an equal weight of the bark; dose, 1 to 6 c.c. (15 to 90 minims) in a liquid preparation.

℞ Fluidextracti cinchonæ .... 2 to 6 c.c. (f℥ss-iss);
Spiritus frumenti vel Jamaicensis .... 45 c.c. (f℥iss);
Syrupi .... 25 c.c. (f℥vj);
Tincturæ cinnamomi .... 5 c.c. (♏lxxx);
Aquæ destillatæ .... 75 c.c. (f℥iiss).
M. Sig.: To be taken in 24 hours. (*Pneumonia with depression.*)

In a *syrup of cinchona* (Codex), 10 per cent., 24 to 48 c.c. (6 to 12 fluidrams) a day, or in a *wine of cinchona* (Codex), 2.5 per cent., 50 to 100 c.c. (1½ to 3 fluidounces) a day.

[*Tinctura cinchonæ*, U. S. P., 20 per cent., 4 c.c. (1 fluidram).

Tinctura cinchonæ composita, U. S. P., 10 per cent. of red cinchona, with bitter orange peel, serpentaria, and glycerin; dose, 4 c.c. (1 fluidram).

Extractum cinchonæ, N. F. IV, yielding 22 to 26 per cent. of total alkaloids; dose, 0.25 grams (4 grains).

Infusum cinchonæ, N. F. IV, 6 per cent., 50 c.c. (1½ fluidounces).

Fluidextractum cinchonæ aquosum, N. F. IV, made with red cinchona; dose, 1 c.c. (15 minims).]

Cinchona lends itself to many combinations with the other tonics, in particular arsenic, phosphorus compounds and strychnine. Thus:

(*a*) ℞ Strychninæ sulphatis .... 0.03-0.05 gram (gr. ss-¾);
Sodii arsenatis .... 0.1 -0.15 gram (gr. iss-iiss);
Sodii glycerophosphatis .... 10 grams (ʒiiss);
Extracti cinchonæ .... 20 grams (ʒv);
Spiritus vini vitis .... 60 c.c. (f℥ij);
Glycerini ....q. s. ad 150 c.c. (f℥v).
Ft. sec. art.
Sig.: One teaspoonful three times daily, just before meals, in a little wine or beer.

(*b*) ℞ Extracti cinchonæ,
Calcii glycerophosphatis .... āā 0.1 gram (gr. iss);
Strychninæ sulphatis ....0.001-0.004 gram (gr. 1/60-1/15).
Ft. pil. No. i. Da tal. No. xxx.
Sig.: Three pills daily before meals.

III.—ANTIRHEUMATICS.

SALICYLATES.



SODIUM SALICYLATE.—$C_6H_4\langle^{COONa}_{OH} + H_2O$.

The major therapeutic indications for sodium salicylate may be roughly set apart as follows:

The first is founded on the almost specific action of sodium salicylate in *acute rheumatism.*

The second is based on its *antipyretic and eliminatory actions;* it tends to dissolve uric acid and render the organic wastes more soluble. This leads to its use in some of the *acute infectious diseases* and metabolic diseases, in particular in the *uric acid diathesis, uric acid lithiasis* and *chronic gout.*

The third is derived from its *cholagogue action,* which makes it one of the best remedies for *improving biliary secretion.*

* * *

Administration of Sodium Salicylate in Acute Rheumatism.—The rules for the administration of sodium salicylate in rheumatic fever have now been very accurately established; they may be summarized thus:

1. Dilute the salt in a rather large quantity of fluid and have it ingested insofar as is possible with the meals, in order to avoid its irritant action on the stomach walls.

2. Divide the daily dose into fractional amounts to be taken every two or three hours, on account of the rapid elimination of the drug.

3. Give the maximum dose deemed necessary already on the first day.

4. Continue the full amount for three days after complete subsidence of the temperature and then diminish the dose gradually until the twentieth day, after which time recovery can be considered as definitely established if no recrudescence of fever has taken place. It may be advantageous, however, to continue this treatment for a much longer time.

In patients up to eight years of age one may give 0.4 gram (6 grains) of the salicylate daily per year of age; 5 grams (75 grains) should, it appears, be considered the maximum dose for a young man; a strong adult free of visceral disease may, however, take 8 to 10 grams (120 to 150 grains) a day.

Sodium Salicylate as a Hepatic Remedy.—Sodium salicylate is increasingly being considered as the most active hepatic drug—the proper remedy for *hepatic insufficiency.*

It brings on and accelerates to maximal speed the flow in the biliary passages, is eliminated in the bile, liquefies it and increases its amount, and is, therefore, the *cholagogue drug par excellence.*

Aside from its cholagogue action, it is said to exert an *antiseptic action. In vitro,* it retards or inhibits the majority of bacterial cultures on gelatin; introduced into the stomach of an animal, it renders the bile aseptic, at least temporarily.

At all events, there results from these various actions a defensive, inhibiting or attenuating effect against primary or secondary bacterial invasions of the biliary tract. It is the best preventive of *cholangitis* and of the *infectious forms of jaundice.* On this basis its use may be advised in the *infectious diseases (typhoid fever).*

Chauffard has lately directed attention anew to the treatment of cholelithiasis as he conceives it more particularly in the cases of *recurring hepatic colic.* This treatment may be summarized as follows: (1) Milk diet, then milk and vegetable diet, and finally a mixed diet including meats in small amount; (2) 1.5 grams (23 grains) of salicylate and of benzoate of sodium taken daily in 3 doses; (3) two pearls of Haarlem oil a week; (4) alkaline baths and dry rubbings.

Salicylates in **Gout** *and* **Lithiasis.**—In chronic gout and uric lithiasis of the urinary tract, sodium salicylate proves serviceable in doses of 2 to 3 grams (30 to 45 grains) a day, kept up for fifteen to twenty days per month, in the intervals between attacks.

Sodium Salicylate as **Antiseptic** *and* **Analgesic.**—The antiseptic and analgesic properties of sodium salicylate warrant its use in the treatment of *throat inflammations* and, in a general way, in the treatment of *infections of the mouth and pharynx* (stomatitis, aphthæ, alveolo-dental infections, eruptions, etc.). It may be prescribed as a mouth wash, gargle or throat wash in 1 to 5 per cent. solutions, according to indications—*e.g.,* 1 per cent. as a wash and 5 per cent. for gargling.

Ramond recommends sodium salicylate in large doses—6 grams (90 grains)—in the treatment of *scarlet fever,* and sees no contraindications to it, either as regards the kidneys or the nervous system. Its action on the complications has seemed obvious to him, particularly against the joint involvements, endocarditis, pericarditis and albuminuria.

Salicylates in **Exophthalmic Goiter.**—In spite of the uncertainty of its effects, sodium salicylate may be tried in exophthalmic goiter, in which at times it gives good results in the average dosage, long continued, of 0.75 to 2 grams (12 to 30 grains) a day.

UNTOWARD EFFECTS OF THE SALICYLATES.—MILD MANIFESTATIONS: *Gastric disturbances:* Burning in the stomach, nausea. *Nervous disturbances:* Brain congestion, tinnitus, vertigo, epistaxis.

MANIFESTATIONS OF INTERMEDIATE SEVERITY: *Hemorrhagic phenomena:* Hematuria, purpura.

SERIOUS MANIFESTATIONS: *Nervous phenomena: Delirium,* "at first quiet, then violent, with impulse to murder and suicide" (Barth); *coma,* resembling diabetic coma (somnolence, dyspnea, coma, acetonemia) in children.

Cardiac Manifestations.—The cardiac manifestations are very serious, and are characterized by a feeling of oppression, pallor, and a frequent, small pulse. Collapse and death have been known to occur. It is, therefore, well to be extremely cautious in the administration of this drug when the heart-action is impaired; it will be advisable to combine a heart stimulant with it (caffeine, strychnine, etc.), and especially, to have the patient carefully watched.

In truth, I have never personally observed any of the serious manifestations above referred to, and mention them only as they are stated by other authors, including some recognized authorities. Many observations on record are open to question. The *"post hoc, propter hoc"* is altogether too simple an explanation in clinical therapeutics, in which so many factors may come into play simultaneously. Acute dilatation of the heart with heart failure can occur in the course of an attack of acute rheumatism in the absence of salicyl treatment.

Many of the accidents on record are, indeed, probably to be ascribed to impurities in the product used, including toxic phenol compounds isomeric to salicylic acid (Caussade and Charpy, *Soc. de thérapeutique,* Jan. 12, 1921), whence the need of using specimens that are as pure as possible.

CONTRAINDICATIONS TO THE SALICYLATES.—According to Barth, the following are *absolute* contraindications:

1. An *abnormal vulnerability of the nerve centers* (neuropathic states, major alcoholism).

2. *Organic heart affections* which predispose to adynamia and syncopal attacks (ulcerative aortitis, vegetative endocarditis, myocardial degeneration, etc.).

3. *Absolute or relative impermeability of the kidneys* (scarlatinal or interstitial nephritis).

To my mind these contraindications are absolute only in the cases in which the conditions of medical practice are such as to preclude close medical supervision of the patient (meaning by this the possibility of seeing the patient two or three times a day).

The following are *relative* contraindications:

1. *Pregnancy,* on account of the condition of renal permeability during this period and also on account of the possible effect of the salicylate on the smooth muscle fibers. In this connection I share the skepticism of Prof. Roger, having often, like him, given the drug with due care during pregnancy without noting any appreciable untoward result.

2. *Old age,* on account of the frequency of arteriosclerosis and of visceral fibroses, particularly involving the kidneys.

MODES OF ADMINISTRATION.

SODIUM SALICYLATE AND SALICYLIC ACID.—*Physical and Chemical Properties.*—Sodium salicylate occurs in the form of a white powder, silky and soapy to the touch; it has a sweetish taste. It contains 80 per cent. of salicylic acid. Its solubility in water is about 1:10; in alcohol, 1:16. *A few drops of ferric chloride solution added to its solutions produce an intense violet color.* These are properties with which one should be thoroughly familiar in order to be able easily to detect, on occasion, fraudulent practices which are the cause of many therapeutic disappointments.

The French Codex recognizes as maximum doses 2 grams (30 grains) as a single dose and 12 grams (180 grains) in twenty-four hours. In a general way, one may put down as a maximum dose for children 0.5 gram (7½ grains) a day per year of age up to adult age.

1. CACHETS.—These [or powders] have little to recommend them, on account of the irritant action on the gastric mucosa. In any case it is well to add an alkali which will partly annul this action. One might thus prescribe:

℞ Sodii salicylatis .... 0.6 gram (gr. ix);
Sodii bicarbonatis .... 0.4 gram (gr. vj).

Pone in cachet. No. i. Da tal. No. xxx.
Sig.: One cachet every three hours with a cupful of milk or some simple infusion.

2. COATED CAPSULES.—In the event of gastric intolerance the drug may be given in capsules coated so as to dissolve only in the intestine.

3. LIQUID PREPARATIONS.—The pharmaceutic form of choice, however, is the liquid preparation, in which one should endeavor to disguise the nauseous taste of the drug and to counteract its action on the stomach by the addition of *sodium bicarbonate.*

(*a*) ℞ Sodii salicylatis .... 12 grams (ʒiij);
Sodii bicarbonatis .... 10 grams (ʒiiss);
Spiritus Jamaicensis .... 40 c.c. (fʒx);
Aquæ destillatæ,
Syrupi aurantii amari ....āā 100 c.c. (f℥iiiss).

M. Sig.: One tablespoonful every three hours. (For an adult with *rheumatic fever.*)

(*b*) ℞ Sodii salicylatis .... 0.5 gram (gr. viiss) per year of age;
Syrupi aurantii florum,
Aquæ destillatæ ....āā 50 c.c. (f℥xiij).
M. Sig.: One teaspoonful every hour. (For a child with *rheumatic fever.*)

4. ENEMAS.

(*a*) ℞ Sodii salicylatis .... 2 grams (ʒss);
Tincturæ opii crocatæ (N. F.) .... gtt. ij;
Aquæ destillatæ .... 100 c.c. (f℥iiiss).
M. Sig.: Use as enema (to be repeated three or four times a day).

(*b*) ℞ Sodii salicylatis .... 16 grams (℥ss);
Acaciæ .... 4 grams (ʒj);
Lactis bulliatæ ....q. s. ad 120 c.c. (f℥iv).
M. Sig.: To be used as enema *ad lib.* in teaspoonful to tablespoonful amounts.

This is a concentrated milk and gum solution containing 2 grams (30 grains) of sodium salicylate in each tablespoonful and which will keep for several days at least (CROUZEL).

5. SUPPOSITORIES:

℞ Sodii salicylatis .... 0.5 gram (gr. viiss) per year of age;
Olei theobromatis .... 4 to 8 grams (ʒi-ij).
Ft. suppos. No. iv.
Sig.: To be used at intervals in twenty-four hours.

6. HYPODERMIC INJECTION.—Various observers have in recent years recommended hypodermic injections of sodium salicylate or salicylic acid in *acute urethritis, polyarticular rheumatism, acute gout, lumbago, sciatica,* etc.

They seem to be effective, but are sometimes sufficiently painful to require a preliminary injection of cocaine.

(*a*) ℞ Sodii salicylatis .... 20 grams (ʒv);
Aquæ destillatæ .... 100 c.c. (f℥iiiss).
S. et sterilisa.
Sig.: Inject 10 to 20 c.c. (2½ to 5 fluidrams) *loco dolenti* (SEIBERT). (Very painful.)

(*b*) Séjournet advocates the use of a *1:1000 solution of salicylic acid.* One cubic centimeter (16 minims) of the sterilized solution is injected *loco dolenti* on two to four successive days, according to results.

(*c*) *Intravenous injections* of a solution containing in each cubic centimeter: Caffeine, 0.05 gram (¾ grain), and sodium salicylate, 0.25 gram (4 grains). The procedure appears to be harmless, but I believe, with Gilbert, that it should be looked upon as an auxiliary mode of administration, to be reserved for serious cases and endocarditic complications.

7. SOLUTIONS FOR EXTERNAL USE.

(*a*) ℞ Sodii salicylatis .... 10 grams (ʒiiss);
Aquæ destillatæ .... 150 c.c. (f℥v).

M. Sig.: Two or three tablespoonfuls in one-fourth glassful of water as a gargle and mouth-wash. (*Sore throat, pharyngitis, stomatitis, eruptive fevers.*)

(*b*) ℞ Sodii salicylatis .... 5 grams (gr. lxxv).

Pone in chart. No. i.
Sig.: Dissolve in ½ liter (1 pint) of warm water for copious throat lavage.

COMBINATIONS WITH SODIUM SALICYLATE.

1. Correctives.

a. SODIUM BICARBONATE.—This tends to counteract gastric irritation and to prevent hyperacidity and acetonemia.

℞ Sodii salicylatis .... 0.6 gram (gr. ix);
Sodii bicarbonatis .... 0.4 gram (gr. vj).

Pone in cachet. No. i. Da tal. No. xxx.
Sig.: One every three hours in milk.

Or:

℞ Sodii salicylatis .... 12 grams (ʒiij);
Sodii bicarbonatis .... 6 grams (ʒiss);
Spiritus Jamaicensis .... 40 c.c. (fʒx);
Syrupi aurantii amari .... 75 c.c. (f℥iiss);
Aquæ destillatæ .... 100 c.c. (f℥iiiss).

M. Sig.: One tablespoonful every three hours.

Or:

℞ Sodii salicylatis .... 6-8 grams (ʒiss-ij).

Pone in chart. No. i. Da tal. No. xii.
Sig.: Dissolve one powder every day in a bottle of Vichy (Célestins) water and consume the latter in wineglass doses taken every three hours.

b. POTASSIUM BROMIDE.—To counteract any tendency to brain congestion.

℞ Sodii salicylatis .... 12 grams (ʒiij);
Potassii bromidi .... 6 grams (ʒiss);
Syrupi aurantii amari .... 90 c.c. (f℥iij);
Aquæ destillatæ .... 120 c.c. (f℥iv). —M.

c. HEART STIMULANTS.—To obviate heart depression.

℞ Strychninæ sulphatis .... 0.02-0.04 gram (gr. ⅓-⅔);
Sodii salicylatis .... 12 grams (ʒiij);
Sodii bicarbonatis .... 4 grams (ʒj);
Syrupi aurantii amari .... 90 c.c. (f℥iij):
Aquæ destillatæ .... 120 c.c. (f℥iv).

M. Sig.: Six tablespoonfuls a day, at three-hour intervals.

In some cases digitalis, digitalin or caffeine might be substituted for the strychnine.

2. Synergists.

a. ANTIPYRIN.—This can be very rationally used as an antineuralgic synergist of the salicylates. As a mixture of sodium salicylate and antipyrin is deliquescent, their administration in a solid preparation is not feasible and a liquid preparation should be used.

This combination is perfectly represented, indeed, in *salipyrin*, a compound of antipyrin and salicylic acid which is prescribed in about the same dosage as the salicylates, *viz.*, 0.2 to 0.5 gram (3 to 7½ grains) a day per year of the patient's age.

℞ Salipyrin	6	grams	(ʒiss);
Strychninæ sulphatis	0.005	gram	(gr. 1/12);
Glycerini	16	c.c.	(f℥ss);
Syrupi aurantii florum	30	c.c.	(f℥j);
Aquæ destillatæ	60	c.c.	(f℥ij).

M. Sig.: To be taken in twenty-four hours in tablespoonful doses three hours apart.

b. SALOPHEN.—For the same purpose, but more especially in the long drawn out cases with but little fever, in rheumatic neuralgias, in gout, in muscular rheumatism and in sciatica, the use of salophen (acetyl-paramidophenyl salicylate) has been recommended. It contains 51 per cent. of salicylic acid, and is generally very well borne.

c. LITHIUM SALICYLATE.—In the treatment of *uric lithiasis,* the salts of lithium have been deemed useful. Of all the urates the most soluble is that of lithium; lithium salicylate is, therefore, indicated for two reasons. Six grams (90 grains) of it represent 1 gram (15 grains) of lithium. It should be ordered taken at the beginning of the meals in daily amounts of 0.5 to 0.6 gram (7½ to 9 grains) in powders, to be dissolved in a glassful of some diuretic beverage or of Evian, Vittel or Contrexéville water.

d. SODIUM BENZOATE.—Benzoic acid appears to enhance the eliminant action of sodium salicylate: Benzoic acid combining with glycocoll gives rise to hippuric acid, which is much more soluble than uric acid, thus facilitating its elimination. Sodium benzoate obtained from benzoin is sometimes considered preferable to that prepared synthetically, which is said to be less well tolerated. Chauffard prescribes:

℞ Sodii benzoatis	10 grams	(ʒiiss);
Sodii salicylatis	20 grams	(ʒv).

Div. in chart. No. xxx.
Sig.: Three powders daily at the beginning of the meals.

Sodium benzoate also appears to have some antiseptic property in the intestine and bladder, which renders it available for use in patients with catarrh of the urinary passages and decomposition of the urine in the bladder. The sodium benzoate being eliminated in

the form of hippuric acid, acts as a vesical antiseptic and restores the urine to approximately its normal composition (Lauder Brunton).

There may be advantage in combining a cathartic with sodium salicylate, as in the following formula:

℞ Sodii salicylatis .... 20 grams (ʒv);
Sodii benzoatis .... 10 grams (ʒiiss);
Rhei .... 5 grams (gr. lxxv).
Pone in cachet. No. xx.
Sig.: Three to six cachets a day, with the meals.

In this connection, *i.e.*, as an antiseptic in the urinary and digestive tract, *phenyl salicylate* (salol) enjoys a deserved reputation in rheumatism and urinary infections, but it contains 38 per cent. of phenol and consequently exposes the patient to erythematous rashes and dark discoloration of the urine.

METHYL SALICYLATE.

Methyl salicylate is a colorless liquid having a characteristic, very penetrating and persistent odor of wintergreen, which is sometimes a disadvantage in its use. It is sparingly soluble in water, and somewhat more soluble in alcohol. It is used almost entirely by external application.

For clinical purposes the following equation may be regarded as valid: *2 grams of sodium salicylate = 2.5 grams of methyl salicylate.*

Manner of Use of Methyl Salicylate.—This is very simple, and may be described thus: Distribute over gauze, absorbent cotton or flannel the amount of methyl salicylate deemed necessary (8 to 12 grams—about 100 to 150 minims); apply over the affected joint, cover with oiled silk, fix carefully with a flannel bandage, and renew at the expiration of 24 hours.

If the odor becomes actually unbearable, one might try rubbing in one of the two following liniments containing salicylic acid:

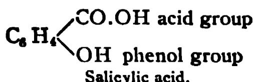
℞ Acidi salicylici,
Adipis lanæ hydrosi ....āā 10 grams (ʒiiss);
Olei terebinthinæ .... 10 c.c. (fʒiiss);
Adipis .... 80 grams (℥iiss). —M.

Or:

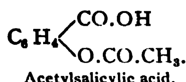
℞ Chloroformi .... 3.3 c.c. (♏liij);
Acidi salicylici .... 5 grams (gr. lxxv);
Olei hyoscyami .... 30 c.c. (f℥j);
Adipis lanæ hydrosi .... 80 grams (℥iiss).
(Blache.)

ACETYLSALICYLIC ACID.

Acetylsalicylic acid or *aspirin* is salicylic acid in which the hydrogen of the phenol hydroxyl has been replaced by an acetyl radical $CO.CH_3$:



Salicylic acid.



Acetylsalicylic acid.

Aspirin may thus be considered an acetic ester of salicylic acid.

1. *Under normal conditions, acetylsalicylic acid breaks up only in an alkaline medium, i.e., in the intestine.*

On this fact is based the customary recommendation to *administer acetylsalicylic acid with water that is neutral in reaction or slightly acidulated or mixed with a little alcohol, or better, with some hot infusion, but never with an alkaline water.* The salicylates, on the other hand, can very well be combined, as is well known, with alkalies.

2. *Under ordinary conditions, absorption and elimination of acetylsalicylic acid are more rapid than is the case with the alkali salicylates.* This is probably the reason why the action of acetylsalicylic acid is more rapid, but also more abrupt and more evanescent.

3. *The antipyretic effect of acetylsalicylic acid sets in earlier and is more marked than that of the alkali salicylates,* at least in acute rheumatism and in pulmonary tuberculosis, in which the reduction of temperature may be considered as constant; *but it is also more evanescent.*

4. *The analgesic effect is, in general, more marked than that of the salicylates.*

5. As regards administration, acetylsalicylic acid presents over the salicylates the *advantage that it can be given in powders to be suspended in water (neutral, acidulated, or with a little alcohol added), as its taste is not unpleasant, or in cachets, since, in general, its irritant action on the stomach is slight or nil,* the drug not being broken up in this organ. [Some gastric irritation may nevertheless occur.—TR.]

In some new patients unaccustomed to the drug, somewhat alarming nervous and cardiac depression, with faintness, cold sweats, etc., may be observed.

Accordingly, it would appear that, particularly in asthenic, debilitated or febrile patients, the following precautions should be taken in the administration of acetylsalicylic acid:

1. Do not exceed 0.3 to 0.5 gram (5 to 7½ grains) as the initial dose, and gradually increase the dose only when the patient's tolerance of the drug—which is generally very considerable—is thoroughly known.

2. Have the drug taken with some hot antidiaphoretic infusion, such as an infusion of sage.

3. If need be, combine with the acetylsalicylic acid a heart stimulant, such as caffeine, 0.05 to 0.1 gram (¾ to 1½ grains) according to the case.

4. At the *beginning* of the treatment, warn the patient's associates of the possibility of copious sweating or even faintness; consequently:

a. Insist that the first doses at least—experimental doses—be taken by the patient in his room, and preferably in bed.

b. That a change of clothing be gotten ready and the room be sufficiently warm, so that, on occasion, the change can be made rapidly and without risk.

c. That strong coffee be kept on hand for use in case of faintness.

MODES OF ADMINISTRATION.

Acetylsalicylic acid may be given in powders, tablets, cachets or solutions to the amount of 1 to 4 grams (15 to 60 grains) or more a day, in fractional and properly spaced doses, *e.g.*, four doses at four-hour intervals.

In children, 0.1 to 0.2 gram (1½ to 3 grains) a day per year of age can be allowed.

Cachets of acetylsalicylic acid, each containing 0.5 gram (7½ grains), with or without 0.05 gram (¾ grain) of caffeine, may be prescribed. In the average case, two to six of these cachets, according to tolerance, may be used in twenty-four hours.

IV.—ANTIAMEBIC DRUGS.

EMETINE AND IPECACUANHA.

EMETINE.—The action of ipecac in dysentery has long been generally recognized, and its systematic and often highly effective use followed the formulation of certain well-known prescriptions for the purpose.

Its employment in later years underwent a complete change by reason of: (1) The differentiation of dysentery into the bacillary and amebic types; (2) the demonstration of the practically specific action of ipecac and its alkaloidal derivative, emetine, on the amebic form (as well as on amebic infections in general).

The striking antiamebic action of emetine, established by Rogers, of Calcutta, has been studied in France by Chauffard, Dopter and Noc, in particular. Its dosage and manner of use were thoroughly discussed before the Société de thérapeutique (May 14, 1919). The following conclusions formulated by Dopter appear to condense rather well the aggregate of observations on the subject.

Dose Limitations of Emetine.—"Injections of emetine may give rise to toxic effects manifested in cardiac, digestive and nervous disturbances sometimes capable of causing death.

"This toxicity of emetine is enhanced by its accumulation in the system and the small amount of it daily eliminated. According to the total amount injected, its elimination may continue forty to sixty days after the last injection, when the patient has received daily treatment for eight to ten days.

"2. On the basis of animal experimentation and therapeutic observation in human subjects, one may estimate that the maximum dose the system can tolerate reaches a total amount of 1.2 gram (20 grains). However, some subjects who have received 0.6 to 0.8 gram (9 to 12 grains) begin to experience a few toxic symptoms.

"In accounting for these discrepancies of tolerance, all depends upon the quality of the emetine, its preparation, the length of time it has been kept, and also, the general resisting power of the patient.

"3. It is therefore wise not to exceed a total dose of 1 gram (15 grains), divided into maximum daily doses of 0.08 to 0.1 gram (1¼ to 1½ grains).

"If toxic symptoms appear before the total dose of 1 gram has been reached, the treatment should be suspended.

"If the occurrence of relapses of amebiasis necessitates several series of emetine treatments, one should wait, before beginning a second series, for complete elimination of the drug taken in the preceding series, *i.e.*, forty to sixty days."

In general, daily hypodermic injections of 0.04 gram (⅔ grain)—exceptionally, 0.06 or 0.08 gram (1 or 1¼ grains)—are given on four or five consecutive days.

The element of risk in the use of emetine seems to have given rise, especially among colonial observers, to a partial change of heart in favor of the *extracts of whole ipecac* administered in suitably coated capsules. Noc advocates for carriers of amebic cysts, and for prophylactic purposes, the use of capsules of extract of ipecac of 0.025 gram (⅖ grain) each—representing 0.1 gram (1½ grains) of powdered ipecac—in the dose of 3 capsules with each meal.

Treatment.—Recognizing the labors of Ravaut and of Mauté in respect of the possibility of a curative effect by the arsphenamins in amebiasis, Noc summarizes the treatment for amebiasis as follows:

1. A daily hypodermic injection of emetine hydrochloride, 0.04 gram (⅔ grain) for four days.
2. An intercurrent intravenous injection of 0.3 gram of neoarsphenamin on the first or the second day.
3. Milk as beverage throughout the duration of the treatment.
4. Small doses of extract of ipecac—pills or globules of 0.025 to 0.1 gram (⅖ to 1½ grains) each—*three* times a week.

5. One or two emetine injections every eight or ten days according as the tendency to relapses is more or less pronounced or the amebic cysts are more or less numerous in the stools, even if the latter present a normal appearance.

6. Reinjection of neoarsphenamin in small doses (0.3 gram) at rather long intervals, concurrently with the injections of emetine.

Recovery from numerous amebic abscesses of the liver, even when far advanced, was often obtained by this method.

Vasodilator and Hypotensor Action.—The vasodilator, blood-pressure-lowering action of emetine is obvious. It appears to be responsible, at least in part, for many untoward occurrences in already depressed subjects. It may, on the other hand, sometimes be availed of successfully for hemostatic purposes, in certain forms of hemoptysis and of uterine hemorrhage or hemorrhages in high pressure cases. As a matter of fact, its action in these cases is uncertain and as yet imperfectly described.

V.—ANTHELMINTIC DRUGS.

The anthelmintics are drugs having for their purpose to rid the body of various intestinal parasites. The drugs used against the nematodes are sometimes termed vermifuges and those used against tapeworms, teniafuges.

The ideal anthelmintic should be (1) harmless to man; (2) toxic to the parasite, which should be killed by it; (3) cathartic. Such an anthelmintic is not known. All the anthelmintics are more or less toxic to man, their action being exerted especially on the nervous system; they must, therefore, be employed with caution; few are actually helminticidal, most of them merely stun the parasite; none is, properly speaking, an evacuant, so that it is almost always necessary to combine a purgative with them.

In general, their action is favored by a relatively empty condition of the intestine, obtained by dietary restriction and the taking of a mechanical evacuant on the day previous to administration of the active drug. Contact of the latter with the parasite seems to be thus better insured, the effect on it being sharper in consequence.

For ordinary practical purposes, it seems best to enumerate here, in respect of the intestinal parasites prevalent in our districts, the most effectual means for their destruction and expulsion.

Oxyuris Vermicularis.—This species of parasite, localized in the rectum, requires only local treatment.

(*a*) ENEMAS of salt, 5 per cent., or of glycerin, 1 per cent.

℞ Tincturæ eucalypti .... 4 c.c. (f℥j);
Sodii boratis,
Sodii bicarbonatis ....āā 4 grams (℥j);
Aquæ .... 500 c.c. (Oj).
M. Sig.: To be used as an enema.

(*b*) SUPPOSITORIES (in obstinate cases):

℞ Unguenti hydrargyri .... 0.02-0.04 gram (gr. ⅓-⅔);
Olei theobromatis .... 2-4 grams (℥ss-j).
Ft. suppos. No. i.

Following is a typical plan of treatment for a child of seven years:

1. ℞ Santonini .... 0.05 gram (gr. ¾);
Hydrargyri chloridi mitis .... 0.25 gram (gr. iv);
Lactosi .... 10 grams (℥iiss).
Pone in chart. No. i.
Sig.: To be taken in the *morning* in a half glassful of sweetened water.

This should be repeated after ten days.

2. ℞ Unguenti hydrargyri .... 0.03 gram (gr. ss);
Olei theobromatis .... 2 grams (℥ss).
Ft. suppos. No. i. Da tal. No. x.

One of these suppositories is to be inserted on retiring and retained over night, beginning only on the day following that of purgation. A suppository should be used on five consecutive days, after which five days' interval should be allowed to elapse and another series of five suppositories then used. During this time, the mouth and teeth should be very carefully attended to. The suppositories should be discontinued or spaced further apart in the event of diarrhea.

3. The child should be kept isolated throughout this period. Each child should have his own toilet articles (towels, brushes, sponges). The hands, and particularly the nails, are to be washed with soap and carefully cleaned with the brush before each meal and after defecation.

Ascaris Lumbricoides.

(*a*) A CATHARTIC, with or without calomel:

℞ Hydrargyri chloridi mitis,
Resinæ ipomœæ,
Rhei pulveris ....āā 0.05 gram (gr. ¾) per year of age.
Ft. pil., tabell., cachet. vel chart.

(*b*) SANTONIN. Maximum doses: single, 0.1 gram (1½ grains); *per diem,* 0.3 gram (5 grains).

℞ Santonini .... 0.2 gram (gr. iij);
Olei ricini .... 70 grams (f℥xviij).
M. Sig.: One teaspoonful every two hours until several stools result.

One might likewise prescribe:

℞ Santonini .... 0.3 gram (gr. v);
Lactosi .... 10 grams (ʒiiss).
M. bene et div. in chart. No. x.
Sig.: One powder every two hours.

(*c*) SANTONICA (*Artemisia pauciflora*), from which santonin is extracted.

1. *Powders:*

℞ Santonicæ pulveris .... 0.5 gram (gr. viiss) per year of age.
Pone in chart. No. i.
Sig.: To be taken in 50 grams (1½ fluidounces) of honey or syrup, either at one dose or in teaspoonful doses morning and evening.

2. *Compound Vermifuge Powder:*

℞ Santonicæ pulveris,
Absinthii,
Sennæ foliorum,
Rhei pulveris ....āā 0.5 gram (gr. viiss) per year of age.
(Average, 5 grams—gr. lxxv).
M. bene et pone in chart. No. i.
Sig.: To be taken in honey or jam.

3. *Enema:*

℞ Santonicæ .... 5-10 grams (gr. lxxv-cl);
Aquæ bulllientis .... 120 c.c. (f℥iv).
M. Sig.: Allow to macerate for 15 minutes and administer lukewarm as enema at bedtime on several consecutive days.

(*d*) OIL OF CHENOPODIUM.—This appears to be at the present time the best vermifuge for ascarides. Unfortunately it is an expensive product, and one difficult to prepare. (See below.)

(*e*) CARBON TETRACHLORIDE has also been successfully used for ascarides. (See below.)

Ankylostoma Duodenale.

(*a*) OLEORESIN OF ASPIDIUM.—Extracted from the rhizome of *Aspidium* (*Dryopteris*) *filix-mas,* or male fern. Dose, 0.5 gram (7½ grains) per year of age.

This drug should always be combined with a cathartic, as it is not itself an evacuant. Most authors consider the use of an oily cathartic, notably castor oil, to be contraindicated in this connection on the ground that filicic acid and the other active constituents of the oleoresin are soluble in oils. Many practitioners, however, do not recognize such a contraindication, and the following formula was observed in a good foreign formulary:

Compound Oil:

℞ Oleoresinæ aspidii .... 2 grams (ʒss);
Syrupi menthæ .... 20 c.c. (fʒv);
Olei ricini .... 26 c.c. (fʒviss).
M. Sig.: To be taken in two doses. (For a child of six years.)

Linctus:

Lemoine's linctus, recalled by H. Leclerc, is quite adequate for present clinical requirements:

℞ Oleoresinæ aspidii .... 0.5 to 5 grams (gr. viiss-lxxv);
Syrupi ætheris (2 per cent.) .... 4 c.c. (fʒj);
Acaciæ pulveris .... 1 gram (gr. xv);
Syrupi .... 10 c.c. (fʒiiss);
Emulsi amygdalæ .... 50 c.c. (f℥iss). —M.

Capsules.—As a matter of fact, I have often employed castor oil as the complementary purgative without untoward result. To avoid all recrimination, even if unjustified, however, it would be well to select some less oily cathartic. Calomel is justly a time honored choice for the purpose.

The following appears to me to be the formula of choice:

℞ Oleoresinæ aspidii .... 0.5 gram (gr. viiss);
Hydrargyri chloridi mitis .... 0.05 gram (gr. ¾).
Pone in caps. No. i.
Sig.: One capsule per year of the patient's age, with 16 to 18 as the maximum number. (Créquy.)

The usual plan is to give these capsules every ten minutes until results are obtained.

(*b*) *Thymol* (enema):

℞ Thymolis .... 5-10 grams (gr. lxxv-cl);
Olei amygdalæ expressi .... 150 c.c. (f℥v).
M. Sig.: For use as enema.

Or better, in a liquid preparation for internal use:

℞ Thymolis,
Sodii boratis ....āā 2-5 grams (gr. xxx-lxxv);
Glycerini .... 48 c.c. (f℥iss);
Elixiris aromatici .... 120 c.c. (f℥iv).
M. Sig.: One tablespoonful every two hours until expulsion occurs.

Thymol is also available against oxyuris and ascaris. It may bring on pains in the stomach, which may be allayed with an alkaline solution or orange flower water.

(*c*) *Oil of Chenopodium.*—This is a product which was formerly very much used and which has again come into favor. It appears to be

the most active drug that can be used against the hookworm. It is also employed with success against ascarides, oxyurides, and the trichocephalus.

Unfortunately it is a toxic drug, and one difficult to prepare. The toxic effects are, however, due to impurities. With a properly prepared product, it appears that these untoward results are becoming less and less frequent.

This drug has an elective action on the auditory nerve and may cause tinnitus aurium, labyrinthine vertigo, and deafness. In therapeutic doses it may cause a slight itching and redness of the palms of the hands and soles of the feet. It should not be given to pregnant women.

Dose: 3 c.c. (48 minims) in 3 fractions, at intervals of one hour, in 30 c.c. (1 fluidounce) of castor oil. Some authors prefer sodium sulphate or magnesium sulphate.

In children there are administered as many drops as the child is years old, multiplied by two.

Riff prescribes at hourly intervals 3 gelatin capsules each containing 15 drops of the oil and one hour after the last one, 40 to 50 c.c. (1⅓ to 1⅔ fluidounces) of castor oil. Children from 6 to 10 years of age receive 1 capsule, and from 10 to 15 years, 2 capsules.

(*d*) *Carbon tetrachloride* is the latest arrival among the vermifuge drugs. It is very much less expensive than oil of chenopodium and is just as effective against the hookworm and ascaris.

Large doses induce fatty or granular degeneration of the liver. The drug is accordingly contraindicated in alcoholics and liver cases. It seems well proven that its toxicity is due to impurities.

Inhalation of the fumes of carbon tetrachloride is harmful. It is therefore prescribed in capsules or simply in a spoonful of water; the latter, being of lower specific gravity, rises to the surface, masks the disagreeable odor of the tetrachloride, and obviates any untoward results due to its inhalation.

Dose: 3 to 4 c.c. (48 to 64 minims) in one dose or in 3 fractions, at one-hour intervals.

Up to 15 years of age: 0.2 c.c. (3 minims) per year of age.

The patient must abstain from alcoholic drinks.

It is not necessary to follow with a purge.

Cestodes (including **Bothriocephalus latus, Tænia mediocanellata** and **Tænia solium**).—The oleoresin of male fern and pomegranate bark or its alkaloid, pelletierine, constitute the remedies of choice.

(*a*) *Oleoresin of Male Fern.*—In a general way, the directions for treatment may be formulated as follows:

1. In the evening of the day preceding that of administration of the teniafuge, the patient should take only milk and a copious simple enema should be given.

2. ℞ Hydrargyri chloridi mitis .... 0.05 gram (gr. ¾);
   Oleoresinæ aspidii .... 0.5 gram (gr. viiss).
   Div. in caps. No. xvi vel xx.
   Sig.: Two capsules to be taken every ten minutes until the parasite is expelled.

3. The patient should defecate into a chamber half-filled with water, in order to avoid rupture of the parasite during the process of expulsion.

4. One should make certain of the presence or absence of the scolex among the fragments evacuated and in the event of absence of the scolex or of incomplete success, the treatment should be repeated only after three months at least and only after spontaneous expulsion of new proglottids.

5. During the treatment the patient should be in bed in order to avoid dizziness and nausea. In the event of weakness, dizziness or faintness, the head should be kept low and a half cupful of strong coffee given.

6. If evacuation fails to occur after the 16 or 20 capsules have been taken, one of the drastic cathartics should be given, such as scammony (0.2 to 0.5 gram—3 to 7½ grains—in a cachet) or compound tincture of jalap (15 c.c.—½ fluidounce).

In children who have trouble swallowing capsules, oleoresin of male fern may be prescribed in a dose of 0.5 gram (7½ grains) per year of age, either in honey or in a liquid preparation of the following type:

℞ Oleoresinæ aspidii .... 0.5 gram (gr. viiss) per year of age;
   Tincturæ vanillæ (N. F.) .. 2 c.c. (f℥ss);
   Syrupi terebinthinæ (10%) . 22 c.c. (f℥vss);
   Syrupi aurantii florum ...... 10 c.c. (f℥iiss);
   Aquæ destillatæ .... 20 c.c. (f℥v).
M. Sig.: One dessertspoonful every ten minutes.

One half to one hour after ingestion of the above preparation has been completed, the child should take:

℞ Hydrargyri chloridi mitis .... 0.05 gram (gr. ¾) per year of age;
   Lactosi .... 10 grams (℥iiss).
Div. in chart. No. ii.
Sig.: To be taken in a little water, ten minutes apart.

If, for some reason, calomel should appear to be contraindicated, one might administer the oleoresin of male fern in a dose of 0.5 gram

(7½ grains) per year of age in pills or in an electuary, as above shown, and follow it in two or three hours with 15 c.c. (½ fluidounce) of compound tincture of jalap or a cachet of 0.2 to 0.5 gram (3 to 7½ grains) of scammony or a saline purgative, such as 30 to 40 grams (8 to 10 drams) of sodium sulphate.

(*b*) *Pelletierine.*—Pelletierine, the alkaloid from pomegranate bark, could be used much more pleasantly were its high toxicity not a limiting factor.

Richaud (*Précis de thérap. et de pharmacol.*) gives the following formula, intended for an adult:

℞ Pelletierinæ sulphatis	0.3-0.4	gram	(gr. ivss-vj);
Acidi tannici	1-1.5	grams	(gr. xv-xxiij);
Aquæ destillatæ	30	c.c.	(f℥j);
Syrupi	22	c.c.	(fʒvss);
Spiritus limonis	gtt. x.		

M. Sig.: To be taken in two or three doses at intervals of 1½ hours.

It is definitely known that in man even doses of 0.5 to 0.6 gram (7½ to 9 grains) of pelletierine may produce dizziness, nausea, vomiting, diarrhea, visual disturbances and numbness of the extremities.

The precaution of administering the drug in the form of the tannate, as in the foregoing prescription, will itself reduce the risks of its administration. [*Pelletierinæ tannas,* U. S. P., average dose, 0.25 gram (4 grains). The sulphate is not official in the U. S. P.].

As with the other anthelmintics, a drastic purgative, such as scammony or compound jalap tincture, or a saline, should be given one or two hours after ingestion of the teniafuge preparation. The French Codex gives 0.4 gram (6 grains) as the maximum dose of pelletierine sulphate to be administered in a tannic solution.

DRUGS ACTING SELECTIVELY ON INFECTIOUS AND PARASITIC DISORDERS (*continued*).

II. NON-SPECIFIC DRUGS.

I.—ANTISEPTICS.

(*Written with the collaboration of* A. LUTIER, M.D.)

Only the **internal** variety of **antisepsis**, or medical antisepsis, will be dwelt on herein. After having awakened, at the beginning of the Pasteur era, boundless hopes in relation both to surgery and internal medicine, it came very near to being generally condemned on account of the disappointments experienced in its application. A concrete analysis of the results already obtained will, however, while bringing out the complexity and difficulties of the problem, permit of a realization of the services that one is entitled to expect from it in the practice of therapeutics.

The question is one of such importance that the Société de biologie devoted a special session to it (Dec. 16, 1918). The following general considerations are reproduced from Prof. Carnot's "Report on the present state of the question of the antiseptics:"

"The biologic problems brought to our attention by antisepsis, far from becoming simpler, appear increasingly complex and difficult to solve. Indeed, it seems almost paradoxical to seek for antisepsis that shall be both toxic to bacterial cultures and harmless to the cells of an infected organism, so that they may kill the former without interfering with the reactions of the latter. Yet the marked advances already made in anti-infectious chemotherapy show that the problem is not an insoluble one, and that even if difficulties remain, one may nevertheless attack them with some chances of success."

Carnot summarizes as follows the data so far acquired regarding internal antisepsis:

Internal antisepsis has two different aims.

(*a*) One of these aims relates to the fight against micro-organisms normally present in our cavities or the agencies of canalicular infections (biliary and urinary tract infections, etc.): *Antisepsis of the canals and cavities.*

(*b*) The other aim relates to the destruction of pathogenic agents, whether these be disseminated in the system or localized in one viscus: It is the cardinal question of the *"sterilization" of infected organisms.*

A. **Antisepsis of the Canals and Cavities.**—This involves the same procedures as wound antisepsis in that frequently one strives to bring an antiseptic into direct contact with the germ to be overcome (digestive tract, urethra, vagina) or, at least, antiseptics eliminated through canals are chosen (urinary, biliary, or respiratory passages).

Increasing recourse is now had to weak antiseptics in dilute solutions, possessed only of incomplete, partial inhibiting power, but non-irritating and non-caustic.

B. **Internal Antisepsis in General Infections.**—A chemical hindering action was used against certain infections long before the beginning of the bacterial era, *e.g.*, the action of mercury and iodide in syphilis, that of quinine in malaria, etc.

Since then, the anti-infectious properties of some other substances have been recognized in a purely empiric manner, *e.g.*, those of potassium iodide in actinomycosis, sporotrichosis, etc.; those of sodium salicylate against the as yet unknown agent causing rheumatism, and those of emetine against the dysenteric ameba.

Lastly, attempts have been made experimentally, with the systematic procedures of chemical synthesis, to perfect the antiseptics by grouping upon various organic or organometallic radicals side-chains capable of altering their fixation, toxicity and antimicrobic power.

The striking experimental results already obtained in respect of the trypanosomiases, leishmanioses, and spirilloses, notably with the organic arsenical compounds, of which arsphenamin has been so far the most thoroughly studied, are familiar to all.

The various products employed successfully as chemical anti-infectious agents are neither caustic nor toxic in the doses ingested or injected; in view of their dilution in the blood and other body fluids, one may well conclude that they circulate in the tissues in amounts that are very far from being toxic.

Generally they are utilized in *inactive forms* which *per se* have little or no antiseptic power. Thus, while salicylic acid is antiseptic, sodium salicylate is scarcely so. While iodine is antiseptic, potassium iodide is scarcely so, and the sporotrichum, for example, will grow well in a medium to which potassium iodide has been added.

It is therefore likely that the antiseptic action of these substances is not direct, but *indirect,* taking place either by virtue of chemical changes effected within the living body, in the lesions themselves, or perhaps

even upon contact with the parasitic germ, or by virtue of a reactive effort on the part of the body, which, under the stimulus of these agents, in its turn produces actively antiseptic substances.

THE PRINCIPAL ANTISEPTICS.—Mention will now be made of the chief drugs used as *internal* antiseptics, with the source, indications and modes of administration of each.

Acetopyrin (antipyrin acetylsalicylate).—A white, crystalline powder with a vinegar-like odor, soluble in hot water and alcohol, sparingly soluble in cold water.

It is analgesic, antipyretic, and an internal antiseptic. It is indicated in influenza, subacute rheumatism and the neuralgias.

Acetopyrin may be given in 0.5 gram (7½ grain) cachets, of which two to four may be taken in a day by an adult.

Acetylsalicylic Acid (aspirin).—White needles, sparingly soluble in water, soluble in alcohol and ether.

Indicated in acute, or rather subacute, rheumatism, influenza, and the rheumatic manifestations following infectious diseases (scarlet fever, etc.).

Dose: Adults: Single, 0.5 to 1 gram (7½ to 15 grains); *per diem,* 1 to 5 grams (15 to 75 grains).

Children: 0.1 to 0.2 gram (1½ to 3 grains) per year of age.

℞ Acidi acetylsalicylici	1-2 grams	(gr. xv-xxx);
Alcoholis	q. s.	
Aquæ ferventis bulliatæ	125 c.c.	(f℥iv);
Glycerini	10 c.c.	(fʒiiss).

M. Sig.: To be used as enema.

Arsphenamin and Neoarsphenamin.—*Systemic Use* (see *Syphilis* and *Arsenic*).

External Use.—Neoarsphenamin yields excellent results when locally applied in Vincent's angina. Before use, a 0.3 gram ampule should be broken open, the contained powder poured out onto a little absorbent cotton, the latter rolled about the tip of a rod, and the whole impregnated with glycerin. The rod is then applied over the ulcerated area.

Benzonaphthol.—A white, crystalline powder, almost insoluble in water. When ingested it breaks up in the digestive tract into its components, *viz.,* naphthol, which remains in the intestine, and benzoic acid, which is absorbed and passes out in the urine.

It is an excellent intestinal and urinary antiseptic.

It may be given, *e.g.,* in a cachet.

Dose: Adults: Single: 0.2 to 0.5 gram (3 to 7½ grains); *per diem,* 2 to 10 grams (30 to 150 grains).

Children: 1 to 2 grams (15 to 30 grains) a day, in divided amounts of 0.2 gram (3 grains).

℞ Benzonaphtholis .... 1 gram (gr. xv);
Syrupi krameriæ (10 per cent.) .... 30 c.c. (f℥j);
Aquæ destillatæ .... 60 c.c. (f℥ij).
M. Sig.: One dessertspoonful every hour.

Betanaphthol Salicylate (betol).—A white, crystalline powder, odorless and tasteless, insoluble in water, soluble in 200 parts of alcohol.

This compound, upon ingestion, is broken up through the action of the pancreatic juice into salicylic acid and naphthol.

It is prescribed as an intestinal and urinary antiseptic.

℞ Betanaphtholis salicylatis,
Sodii benzoatis ....āā 0.25 gram (gr. iv).
Pone in cachet. No. i. Da tal. No. xxx.
Sig.: Four to eight cachets a day.

Calomel (mercury protochloride).—A fine white, crystalline powder, odorless, insoluble in water, alcohol and ether.

Used in small, fractional doses as an intestinal antiseptic. For this purpose it is employed in typhoid fever, influenza of the digestive type, and dysentery.

℞ Hydrargyri chloridi mitis .... 0.01-0.05 gram (gr. 1/6-3/4);
Lactosi .... 0.5 gram (gr. viiss).
Pone in chart. vel cachet. No. i. Da tal. No. iii.
Sig.: Three powders in the evening at hourly intervals, followed next morning by purgation with castor oil or sodium sulphate.

In children, 3 similar powders of 0.01 to 0.02 gram (1/6 to 1/3 grain) each may be given one hour apart, in a little water or milk.

Collargol (colloidal silver).—(See also *Colloidal Metals*).

This is administered by the mouth, or better, by intravenous injection; sometimes, especially in children, by inunction.

℞ Collargol .... 0.01 gram (gr. 1/6);
Lactosi .... 0.1 gram (gr. iss).
Glycerini .... q. s.
Ft. pil. No. i. Da tal. No. xx.
Sig.: Two or three pills a day.

℞ Collargol .... 1 gram (gr. xv);
Aquæ destillatæ .... 100 c.c. (f℥iiiss);
Ovi albuminis recentis (N. F.) .... 1 gram (gr. xv);
Glycerini .... 0.8 c.c. (♏xij).
Sig.: Three teaspoonfuls a day, shortly before meals.

Ampules containing 5 or 10 c.c. of 1 per cent. collargol may be secured for daily intravenous injections. No heat should be applied to the ampules; otherwise the collargol will be partly precipitated.

℞. Collargol	15 grams (℥ss);	
Adipis benzoinati	90 grams (℥iij);	
Ceræ albæ	10 grams (ʒiiss).	—M.

The above ointment (CREDÉ'S) is rubbed in, morning and evening, on the flexor aspects of the joints or in the axillary regions, to the amount of 1 to 3 grams (15 to 45 grains), according to the age of the patient. The skin should previously have been washed with soap and then with ether, in order that the pores may be as permeable as possible. The rubbing should be kept up energetically for fifteen or twenty minutes. A layer of some impervious material is then applied.

Colloidal Copper, Gold, Platinum, Selenium and Tin.—(See *Colloidal Metals*).

Colloidal Platinum, Electrically Prepared (Electroplatinol).—This is an isotonic colloidal pseudo-solution of platinum in very fine particles, obtained by the electric method. It is a gray, very stable fluid.

It may be used as a systemic antiseptic in all grave infections, especially streptococcus infections, erysipelas and pneumonia, by intramuscular, or better, intravenous injection.

It is a powerful phagocytic and hematopoietic stimulant.

Emetine Hydrochloride.—Emetine is an alkaloid obtained from ipecac root. The hydrochloride is a white, crystalline powder, turning yellow on exposure to light, freely soluble in water and alcohol.

It is used in amebic dysentery. Though well borne in ordinary doses, it becomes toxic if the daily dose is a little too large, and especially, in the course of a series of daily injections, when the total amount given approaches 0.8 or 1 gram (12 or 15 grains), as shown by general lassitude, sensitiveness of the neck, and flaccid paresis of all muscles, with some difficulty in voluntary motion, including mastication and deglutition. It is ineffectual in the encysted forms of amebic dysentery.

Ampules of 0.04 gram (⅔ grain) of emetine hydrochloride may be obtained for subcutaneous injection at the rate of one or two ampules a day, repeated for ten to fifteen days (up to a total amount of 0.8 gram—12 grains; 1 gram—15 grains—should never be exceeded). The injections are then discontinued for ten or twelve days.

One month after recovery, a new series of injections for eight days should be given.

Haarlem Oil.—This is perhaps identical with oil of cade, is obtained by distillation of *Juniperus oxycedrus,* and occurs in the form of a brown-

ish black, syrupy fluid with an empyreumatic odor and an acrid, caustic taste. Though boycotted by the majority of pharmacologists, it is appreciated by the clinicians and, after being used empirically for ages, is prescribed by Chauffard in cholelithiasis and by A. Robin in chronic pyelonephritis. Its favorable action appears to me unquestionable in hepaticobiliary and urinary infections.

In these cases it should be prescribed in doses of 10 to 12 drops in milk, to be taken just before breakfast, or better in enteric-coated capsules (intended to dissolve only in the intestine) each containing 5 drops, two to four such capsules being taken with the breakfast.

Helmitol (neourotropin).—This is a compound of urotropin and methylene-citric acid, occurring as a colorless crystalline powder with an acid taste, soluble in 15 parts of water, almost insoluble in alcohol.

It decomposes in the intestine into its component parts; the methylene-citric acid, upon absorption, leads to elimination in the urine of a small proportion of formaldehyde in combination; the urotropin also produces its own separate effect.

It is prescribed in pyelitis, pyelonephritis and cystitis as a urinary antiseptic. Prolonged use of it may induce abdominal pain and frequent, burning urination.

Helmitol may be prescribed in 0.5 gram (7½ grain) tablets or cachets. The customary dosage is 3 to 4 grams (45 to 60 grains) a day.

Hydrogen Dioxide.—This is used in solution as a colorless, odorless liquid, rather often acidified by the addition of a very small amount of a strong acid (as preservative). It embodies 2 to 15 volumes of oxygen, which it yields very readily, and various impurities (baryta, etc.). It may be neutralized just before use by the addition of a few centigrams of sodium bicarbonate.

It is used as an antiseptic, for gargling or as a mouth wash, in thrush, sore throat, gingivitis, etc.; also for vaginal injections. One part of the solution may be added to 5 parts of boiled water for irrigation of the pharynx, mouth, etc.

[*Liquor hydrogenii dioxidi,* U. S. P., is required to contain at least 3 per cent. by weight of H_2O_2.]

Iodine.—Iodine occurs in violet-black scales, almost insoluble in pure water, soluble in 10 parts of alcohol. Addition of potassium or sodium iodide makes it dissolve in water readily and renders the solution stable.

Reference is made here only to its use as an internal antiseptic. For this purpose it has been used mainly in typhoid fever and also

in pneumonia, erysipelas, the septicemias, and tuberculosis, especially when involving the lymphatics or bones.

It is given by the mouth or hypodermically.

Four drops of U. S. P. tincture of iodine (7 per cent.) contain approximately 0.005 gram (1/12 grain) of iodine. The ordinary dosage is from 0.005 gram (the U. S. P. average dose) to 0.05 gram (3/4 grain), *i.e.*, from 4 to 40 drops. The ascent in dosage should be gradual.

The iodine should be administered in fractional amounts in the course of the day in a little milk, or better, to avoid its precipitation, in a wineglassful of some heavy wine, such as Malaga.

Ampules of *colloidal iodine* in oily suspension, 2 c.c. (32 minims) each, may be obtained for daily intramuscular injections, which are painless.

Lactic Acid.—This is a syrupy liquid, colorless, odorless, and with an acid taste. It is freely soluble in water, alcohol and glycerin.

It is used particularly to antagonize the bacillus of infantile green diarrhea and also in simple diarrhea in adults and in the diarrhea of tuberculosis.

It is administered in a mixture, or better, in lemonade.

Adults: Ordinary dose: 2 to 10 c.c. (30 to 150 minims) a day.

℞ Acidi lactici .... 4 c.c. (f℥j);
Aquæ aurantii florum,
Aquæ destillatæ ....āā 50 c.c. (f℥iss);
Syrupi .... 20 c.c. (f℥v).
M. Sig.: One tablespoonful every two hours.

Children: Ordinary dose: 0.25 to 2 c.c. (4 to 30 minims) a day.

℞ Acidi lactici .... 2 c.c. (♏xxx);
Aquæ destillatæ .... 100 c.c. (f℥iiiss);
Syrupi cydoniæ .... 30 c.c. (f℥j).
M. Sig.: One teaspoonful every fifteen to thirty minutes.

A 1 per cent. lactic acid lemonade may be ordered, or the following:

℞ Acidi lactici .... 10 c.c. (f℥iiss);
Syrupi limonis .... 200 c.c. (f℥vj);
Aquæ destillatæ .... 800 c.c. (f℥xxv). —M.

The dose of either of the above liquids is ½ to 1 liter (1 to 2 pints) in adults and 100 to 200 c.c. (3½ to 7 ounces) in children. They are to be taken in half-glassfuls at hourly intervals.

Lactic Ferments.—(See *Bacteriotherapy.*)

Melubrin.—This is an antipyrin derivative obtained by the introduction of the methylene-sulphonic group.

It is a colorless, crystalline compound, with a slightly bitter taste suggesting that of antipyrin, soluble in 1 part of cold water, slightly

soluble in alcohol, deteriorating upon exposure to light and decomposing in aqueous solution.

It is prescribed in rheumatic fever, in which it acts as an analgesic and anti-infectious agent, after the manner of a specific drug. It causes the temperature to recede and produces a characteristic effect on the swellings and mobility of the joints.

It is very well borne, even in large doses.

It may be prescribed in a solution, provided this be made immediately before use, as it deteriorates rapidly. It is, therefore, preferably prescribed in 1 or 2 gram (15 or 30 grain) powders or in 0.5 gram (7½ grain) cachets. It acts well only in large doses.

Dose: Adults: 4 to 8 grams (1 to 2 drams) in the 24 hours, up to 10 grams (150 grains), in divided amounts of 1 or 2 grams (15 or 30 grains) repeated three to six times a day.

Children: At two years: 1 gram (15 grains) a day, in divided amounts of 0.25 gram (4 grains). Above two years, one-fourth or one-half the adult dose, according to age.

A 3-gram (45 grain) powder of melubrin may be ordered, to be dissolved in 100 c.c. (3½ ounces) of boiled water and administered as an enema, three times a day.

Mercury.—(See also separate sections on *Mercury* and *Syphilis.*)—Mention will here be made only of injections of mercury bichloride and cyanide, given for systemic antiseptic purposes.

Bichloride.—This may be used by intravenous injection in the treatment of gonorrheal rheumatism, refractory local complications of gonococcus infection, and in infections and suppurations, furunculosis, carbuncle, acute adenitis and erysipelas. A 1:1000 solution may be injected in doses of 3 to 5 c.c. (45 to 75 minims) for one or two days, up to five days.

Cyanide.—Intravenous injections of the cyanide may be given in pyemia, puerperal sepsis, and septicemia. A 1:100 solution is injected in doses of 1 to 2 c.c. (15 to 30 minims) daily or on alternate days for five or six days. If irritation of the vein intima is feared, a more dilute solution, such as 1:200, might be used.

Methylene Blue.—A dye derived from anilin, occurring as a dark blue powder, soluble in water and in alcohol.

It is used for local applications in sore throat, especially Vincent's angina; in stomatitis, especially Vincent's fusospirillar stomatitis, and in enemas in dysentery.

℞ Methylthioninæ chloridi .... 1 gram (gr. xv);
Alcoholis,
Glycerini ....āā 5 c.c. (♏lxxx).
M. Sig.: For local application.

℞ Methylthioninæ chloridi .... 0.2 gram (gr. iij);
Aquæ bulliatæ .... 1 liter (Oij).
S. Sig.: To be used lukewarm for bowel irrigation two to four times a day.

Potassium Iodide.—(See separate section on *Potassium Iodide.*)

For hypodermic injections of iodine, preparations of the type of *iodipin* may be used. Iodipin is a yellowish oily fluid, consisting of oil of sesame in which, for hypodermic use, 25 per cent. of iodine has been introduced. The dose is 2 to 6 c.c. (30 to 90 minims), repeated on alternate days or even daily. The injection should be carried out very slowly—not more than 1 c.c. to the minute. When the needle is introduced care should be taken to make sure that it has not entered a vein.

Potassium Permanganate.—Occurs in shining, dark-colored scales or crystals, purplish when held up to the light, and soluble in 15 parts of water. (Stains of potassium permanganate may be removed by washing with a 10 or 20 per cent. solution of sodium bisulphite or hyposulphite.)

It is an antiseptic of great value, by virtue of its decomposition by organic matter; nascent oxygen is set free in the process, actively oxidizing the organic matter.

The drug is used particularly for the disinfection of body cavities (mouth, vagina, urethra, bladder, etc.). It may be prescribed in a 0.25 gram (4 grain) powder, to be dissolved in 1 liter (34 fluidounces) of boiled water, a 1:4000 solution resulting.

Quinine.—(See separate section on *Quinine.*)

Silver Nitrate.—This is indicated as an enema in dysentery and chronic varieties of diarrhea and in the form of washes for antiseptic purposes in cavities such as the mouth, throat, vagina, etc.

Enema:

℞ Argenti nitratis .... 0.1-0.3 gram (gr. iss-ivss);
Aquæ destillatæ .... 300 c.c. (f℥x).
M. Sig.: Use as an enema, to be retained five to fifteen minutes.

As a *wash,* for the purposes mentioned above, a 1:10,000 solution of silver nitrate may be prescribed.

Sodium Hypochlorite.—*Labarraque's solution* (*Liquor sodæ chlorinatæ,* U. S. P.) is made by decomposing chlorinated lime, 10 parts, with monohydrated sodium carbonate, 7 parts, and water, to make 100. It is required to contain not less than 2.5 per cent. of available chlorine. It has a slight odor of chlorine. It should be kept protected from exposure to the air or to light.

It is an excellent antiseptic for gargling and irrigations in sore throat and stomatitis, and for vaginal injections in leukorrhea, metritis, etc. For such purposes 1 to 3 tablespoonfuls of it may be added to 1 liter (34 fluidounces) of boiled water.

Sodium Salicylate.—(See separate section on *Sodium salicylate.*)

Urotropin.—This compound, also known as hexamethylenamin, hexamin, formin, aminoform, cystogen, etc., and official as *Methenamina,* U. S. P., occurs in white crystals, almost tasteless, and freely soluble in water (81.3 per cent.).

It is used as a *urinary antiseptic* in pyelitis, pyelonephritis, cystitis and all cases of retention of urine (in prostatics, etc.); as a *biliary antiseptic* in cholelithiasis, the infectious forms of jaundice, cholangitis, and cholecystitis, and as *internal antiseptic* in the general infectious diseases, especially typhoid fever, which may be accompanied by infection of the biliary tract and by bacteriuria.

The ordinary dosage is 1 to 2 grams (15 to 30 grains) a day. Tablets or cachets each containing 0.5 gram (7½ grains) may be prescribed. [The tablets should be broken up in water, and the cachets followed by a drink of water.] Liquid preparations are also suitable, *e.g.:*

℞			
Methenaminæ	2.5 grams	(gr. xl);
Aquæ aurantii florum	5 c.c.	(♏lxxx);
Syrupi acaciæ	25 c.c.	(f℥vij);
Aquæ	120 c.c.	(f℥iv).

M. Sig.: Five tablespoonfuls a day.

II.—ANTIPYRETICS.

Antipyretic medication is often a useful and at times an indispensable auxiliary in the treatment of infections.

It is brought into play with the *antipyretic drugs* described in an earlier chapter; with *quinine,* also previously dealt with, and with physical measures, particularly *hydrotherapy,* the modes of application of which will be described in the section on *Physical Measures.*

All these considerations, including their clinical application, will be found summarized and correlated in the section on Fever, in Part III (*Treatment of Symptoms*).

III.—LEUKOCYTOGENIC AGENTS.

Whatever view be entertained as to the precise nature of the process antagonizing infection, there is no doubt that the leukocytes play a rôle of the first order therein, that systemic resisting power is in a measure proportionate to the leukocytic reaction excited by

infection, and that it may consequently be of advantage to stimulate this reaction in cases in which it is insufficiently manifested.

Many anti-infectious agents possess a stimulating action on the leukocytes, and it may be stated in a general way that such an action is a very common one, and that it follows administration by the subcutaneous, intramuscular and especially the intravenous route of the majority of substances foreign to the organism.

The most commonly employed leukocytogenic substances are:

1. *The true serums and the artificial serums, in particular isotonic sugar solution.*

2. *The colloidal metals, especially by the intravenous route.*

3. *Sodium nucleinate by intramuscular injection (10 to 20 c.c.—150 to 300 minims—of a 1 per cent. solution in physiologic salt solution).*

4. *Oil of turpentine (fixation abscess).*

To these may probably be added:

5. *Sugar (Lo Monaco).*

6. *Peptone (Nolf), given intravenously.*

The matter is not, however, so simple as one might expect, for whereas natural immunity is to be ascribed essentially, it seems, to the activity of phagocytosis, acquired immunity, and often the resolution of infections, appears to result less from phagocytic exaltation than from a decidedly complex process in which there take part mainly changes in the tissue fluids which are as yet very imperfectly known, and in particular changes in the colloidal equilibrium characteristic of blood serums. Most of the substances above mentioned, including the colloidal metals given intravenously, the true serums, and peptone in particular, seem to act in the latter manner, a brief description of which will be given in the succeeding section.

THE COLLOIDAL METALS.—Grounds for Prescribing the Colloidal Metals.—The colloidal metals were introduced in therapeutics in relatively recent times. Their study is both of practical and of theoretic interest; practical, because they now constitute one of the most useful agents in anti-infectious medication; theoretic, because they are capable of evoking reactions similar to those of the ferments—which are likewise colloidal—and pharmacologic effects very comparable to those observed with the antitoxic serums, such as diphtheria antitoxin.

This interest has markedly increased in late years by reason of the increasing importance of the study of colloidal statics and the disturbances of colloid equilibrium, both in medical diseases and their treatment.

This similarity in the action of colloid metallic solutions and of those substances the precise nature of which is as yet poorly defined, and which are known as enzymes or ferments, has led to the application to such solutions of the terms "inorganic ferments" (Bredig) and "metallic ferments" (Robin).

The colloidal metals possess certain properties in common with the ferments.

1. *Like the ferments, they act in infinitesimal amounts, and are active and powerful catalytic agents.*

2. *They act as oxidizing ferments.*

3. *This catalytic action, maximal at a certain temperature, is destroyed by heat.*

4. *They are precipitated from their solutions by electrolytes.*

The colloidal metals exert on the system an action very similar to that exerted by certain therapeutic serums.

There exists, on the whole, a very great similarity between the *artificial crisis* induced by the use of the colloidal metals or antitoxic serums and the *spontaneous crisis* which marks the termination of infectious diseases, such as pneumonia.

Further, as we have already seen in various sections of this work and shall have occasion to note again in several others, many forms of medication (colloidal metals, serum therapy, protein therapy, etc.) constitute merely particular instances of a more general form of medication, *viz.*, colloid therapy, the essential action of which seems to reduce itself more or less to an action of varying intensity on the cellulo-seric colloid complex which constitutes the blood, whether this action be a stabilizing (desensitizing) one or, on the other hand, a flocculant (precipitant) one, inducing a hemoclastic shock very comparable to the pathologic forms of shock.

At all events, the action of the colloidal metals is essentially a colloidal action, the physical, colloidal specificity of the substance greatly preponderating over its chemical specificity, which is usually negligible.

In short, "the therapeutic properties of the colloids can be accounted for neither by the antiseptic power some of them possess—a property which is, furthermore, problematic—; nor by their catalytic properties, which are the attributes, but slightly marked, of only a few colloids, nor by their chemical properties. The phenomena taking place between colloids or between electrolytes and colloids are alone to be invoked to afford elucidation of this undeniable curative action. Thus, there are concerned either immediate phenomena of shock by contact, due to a flocculation (action on the micellæ) or to

an agglutination or lysis (actions on the cells); or, in other instances, remote, secondary, chronic phenomena, causing a disturbance of the normal life of the cells and manifesting itself in sensitization." (Kopaczewski.)

The fact should not be overlooked, moreover, that as yet we have hardly gotten out, as far as the colloidal metals (and colloid therapy in general) are concerned, of the stage of pure empiricism. The necessary scientific, experimental, accurate study of the subject—on the basis of investigations of the degree of dispersion, of the intensity of the electric charge, of the amplitude of the Brownian movements (fundamental and characteristic features of colloid agents), and of definite physicochemical serum changes, *viz.*, specific gravity, viscosity, surface tension and electric conductivity—still remains to be made.

When to Prescribe the Colloidal Metals.—To summarize the indications for the colloidal metals, it may be stated that, *aside from the cases of infection in relation to which an accredited specific serum is available* (diphtheria), *they are the most potent and most reliable anti-infectious agents now known,* and that *it is proper to use them systematically in any infection, of whatever nature and location, if such infection be serious, refractory or attended with some complication.*

It should be realized however—and this is plainly a rather disappointing feature of this form of treatment—that the results are not constant and that sometimes quite different results will be obtained in apparently similar cases; after a case exhibiting an almost miraculous result, inappreciable results may be seen in a similar case treated with an apparently identical technic. This proves, at the most, that there is still in the infections an individual factor of which we know little, and should lead us not to neglect, when using the colloidal metals, the usual therapeutic measures (baths, serums, sodium salicylate, etc.). Poor quality of the colloid product used and faulty technic also certainly account for many failures of the treatment.

MacDonagh has published extremely suggestive, though decidedly conjectural studies on the subject of the colloidal agents and of the chemotherapy of the colloids. It may be recalled that the processes of defence against infection appear to him mainly as intra-colloidal, intra-organic processes of oxidation and reduction. His original, practical conclusion, which is reproduced here merely by way of suggestion, is as follows:

"On the whole, the metals act as oxidizing agents and the non-metals as reducing agents. Therefore, one should use the metals in preference to the non-metals in the acute stages of an infection, and preferably the non-metals in the chronic stages."

Manner of Use of the Colloidal Metals.—The colloidal metals are most commonly used by *inunction, intravenous injection* and *intramuscular injection.* There is no doubt that the intravenous route is the method of choice in the administration of colloid agents.

1. INUNCTION.—The product oftenest employed in this manner is *collargol,* an impure preparation of colloidal silver obtained by chemical means and containing a relatively high percentage of the metal.

One may prescribe:

℞ Collargol .... 10 grams (ʒiiss);
Adipis lanæ hydrosi .... 15 grams (℥ss);
Adipis .... 25 grams (ʒvj).
M. Sig.: For external use.

A 15 per cent. collargol ointment may be ordered made up in 10 papers each containing 3 grams (45 grains). The contents of one to three papers, according to indications, may be administered by inunction in one day.

The rubbing should be done over areas where the skin is thin. The areas of election for mercurial inunction (bend of the elbow, axilla, popliteal and inguinal regions) are very suitable for the purpose.

The area should be washed with soap and water, cleansed with the brush, washed with ether, and prepared like an operative field in order to render the pores more permeable and dilate the capillaries—in short, to increase the absorptive power of the skin.

The rubbing should be rather vigorous, and in particular, should be continued for at least twenty to thirty minutes, in order to secure a maximum amount of absorption. After the rubbing, with the ointment allowed to remain *in situ,* a layer of cotton and an impervious tissue held by a bandage should be applied. This dressing should be permitted to remain for several (six to twelve) hours, at the end of which time the ointment should be removed with soap and water.

2. SUBCUTANEOUS AND INTRAMUSCULAR INJECTIONS.—Such injections are made in the usual way; they may be carried out likewise with solutions of collargol or of colloidal metal prepared with the electric arc. The latter are, indeed, definitely to be preferred, as injections of collargol have sometimes been known to give rise to inflammatory swellings and even abscess formation.

3. INTRAVENOUS INJECTIONS.—The technic is that of intravenous injections in general.

One may inject either a collargol solution or solutions of colloidal metals electrically prepared (Bredig's solutions). The latter are to be preferred.

As regards the exact choice of one or the other variety (chemical or electric) of a colloidal metal, I agree with the following statements of Netter:

"In choosing between a colloidal agent prepared chemically or by the electric method, the decision should be based on the effect sought.

"If the physical, catalytic effects are particularly to be brought into action, it will not be necessary to use concentrated solutions, and electrargol may prove the equivalent of collargol.

"If a bactericidal action is desired, one should endeavor to use large doses, and in this event collargol, which goes into solution to the extent of 5 per cent. or more, is more reasonably to be used than electrargol, the average concentration of which is 0.025 per cent."

Indications for the Colloidal Metals.—The following general indications for these various products have been formulated:

A.—ELECTRICALLY PREPARED COLLOIDS.

Electrargol (silver).
Electraurol (gold).
Electroplatinol (platinum).
Electropaladiol (palladium).
Electrorhodiol (rhodium).
Electrocuprol (copper).
Electro-Hg (mercury).
Electroselenium (selenium).
Electromartiol (iron).

General Therapeutic Applications.—Pneumonia, bronchopneumonia, capillary bronchitis, influenza, tonsillitis and pharyngitis, rheumatic affections, erysipelas, typhoid fever, typhus fever, scarlet fever, measles, smallpox, tetanus, puerperal septicemia, Asiatic cholera, Malta fever, acute pemphigus, acute meningitis.

Local Uses of Electrargol.—Mammary abscess, suppurative pleurisy, abscesses, felon, furuncle, epididymitis, mastoiditis, eye diseases.

Special Indications of Individual Colloidal Metals:

Copper: Infectious diseases, cancer, tuberculosis.

Mercury: All forms of syphilis.

Selenium: Cancer.

Iron: Anemic syndrome.

B. CHEMICALLY PREPARED COLLOIDS.—Colloidal sulphur: Chronic rheumatism.

Under the general name "collobiase" (of silver, gold, sulphur, platinum, etc.), certain pure colloidal agents are being marketed in France. Gold collobiase is stated to have proven superior in its effects to the preparations of colloidal silver.

Mixed colloidal preparations combining several colloids for a definite therapeutic purpose, *e.g.*, an arsenic-mercury-gold collobiase for syphilis, have also been prepared.

IV.—COLLOID THERAPY IN GENERAL.

I. Cell-colloid-serum Balance. Immunity.

The *blood,* or essential, vital circulating constituent of the body, is made up of:

1. *Cells:* Erythrocytes and leukocytes containing various, for the most part colloid, protoplasmic components in suspension and in biologic equilibrium.

2. The *blood serum,* a colloidal complex, consisting, among many other components, of *various electrolytes,* such as sodium chloride, sodium phosphate, etc., and *colloid particles* which are themselves complex.

Even elementary studies of the colloidal pseudo-solutions have long since revealed that the equilibrium of these colloids is highly unstable, and that in many instances even the slightest physicochemical modification, with variation of temperature, the addition of electrolytes or colloids, the passage of an electric current, etc., is sufficient to cause in such solutions profound changes ordinarily manifested by increased size of the colloid micellæ and their agglutination, flocculation, precipitation, etc.—in short, a rupture of their state of equilibrium and a more or less rapid and complete loss of the suspensive, liquid, colloid condition.

The same must *a priori* be true of the colloid, cellulohumoral complex constituting the blood, and this strictly physicochemical orientation, which tends toward no less an object than to make of the biologic reactions of the blood a distinct chapter of colloid physical chemistry is, as we shall see, extremely fruitful.

Yet—though the comparison is not a perfect one—the experimental colloid pseudo-solutions are, for the most part, lifeless fluids from the biologic standpoint, fluids which submit passively to any changes imposed on them. The blood, on the other hand, is an essentially living medium, which circulates, reacts actively to disturbing influences, and shows an inherent tendency to continue its existence, *i.e.,* to adapt itself, thanks to a more or less perfectly ordered self-regulatory mechanism, to new conditions in order to remain in its suspensoid state and defend itself against flocculation—the precipitation which really constitutes death of the colloid.

* * *

As a matter of fact, under normal conditions:

1. The suspension and the biologic and consequently isotonic balance of the cellular elements in the blood-serum is relatively very stable.

2. The stability of the blood serum is likewise very considerable and is insured between rather broad limits against disturbing influences. Yet, even under conditions of normal health, cell-serum and colloid-serum stability is only a relative stability. The limits of stability vary widely according to the individual; when they are trespassed—which may occur at any time even in a normal patient—the rupture of equilibrium is manifested:

1. By *destruction of the cells* through *rupture of the cell-serum isotonic equilibrium.* The bursting of the erythrocytes in particular sets free the intra-cellular hemoglobin, which dissolves in the serum—this process being termed hemolysis.

2. In regard to the *rupture of colloid-serum balance,* by the phenomenon known in physical chemistry as "flocculation," which consists of a more or less complete and extensive precipitation of the colloid particles and a series of reactive phenomena, such as fall in blood-pressure, leukopenia, etc., generally designated by the term *shock.*

A large number of morbid states—of which only a few are as yet well known and listed—*appear precisely to be characterized by a state of marked instability either of the cell-serum balance, or of the colloid-serum balance, or of both.* These conditions of balance, which are essential to health, are insured only within very narrow and readily overstepped limits, whence there easily results an obstinate and recurrent onset of paroxysmal crises of hemolysis or flocculation which may lead to the production of a wide variety of clinical pictures.

* * *

The **rupture of cell-serum balance,** and more particularly of blood-serum balance, with associated hemolysis, is met with in an almost pure type in *paroxysmal hemoglobinuria.* The cell-serum instability in this condition is such that the least exposure to cold induces hemolysis. The cell-colloid-serum complex is "sensitive to and upset by the cold," as Widal puts it.

To this typical condition of instability of the blood may be assimilated also all the disorders with hemorrhagic tendencies, *hemophilia* and *purpura* in particular.

These typical disturbances with blood instability have placed us on the track of a therapeutic method destined to have a great future and which is one of extreme theoretic importance.

Emile Weil, already in 1905, had observed the *favorable and sometimes lasting effects obtained in hemophilia with injections of fresh horse serum.* Nolf and Henri, in subsequent systematic investigations, brought out the

whole significance of this therapeutic phenomenon by showing that ***the horse serum acted merely as a foreign protein,*** and that, as a matter of fact, repeated hypodermic injections of a solution of peptone—a non-humoral, but specific proteic substance—brings about in a general manner in all hemorrhagic states (hemophilia, hemoglobinuria, purpura, etc.) not only cessation of the hemorrhages but also often a more or less firm and lasting stabilization of the hematic complex, and with it more or less complete recovery. Protein therapy has thus been created and placed on a solid foundation. The subsequent labors of Bordet, Widal and his coworkers, etc., were to give to this therapeutic method an unsuspected extension.

Concerning the exact mode of production of this curative action we know very little as yet, and one can scarcely say more about it than does Bordet in the following suggestive lines:

The Ferments and Chemical Equilibrium (Bordet: "Immunité," pp. 629, 630, etc.).—"The protein materials which we ingest as food have to be rendered soluble to be absorbed; but we know it to be also necessary for the digestive juices to subject them to a rather thorough disintegration. Every species places, indeed, as the specificity of the immune serums shows so clearly, its own imprint on the albumins of which the system is formed. These must, therefore, when ingested by a living body which proposes to assimilate them unto itself, first of all lose their original, earlier imprint before they receive, in the course of reconstruction, a new stamp.

"Accordingly the voluminous molecular collections taken in break up into fragments which the elaborating organs, notably the lymphatic system conjoined to the intestine and liver, seize upon in order to submit them to synthetic processes and dispose them in a molecular arrangement, the secret of which they hold and which characterizes chemically the species concerned..

"The organs of rearrangement and purification intervening between the digestive tract and the blood see to it carefully that the latter shall receive only nitrogenous matters that have already undergone the whole series of required transformations, *i.e.,* a severe process of selection is effected. It is this very strict control which guarantees to the various tissues and organs due regularity of replenishment and perfect appropriation of the materials they require and which the blood brings to them.

"Each type of cell represents, from the standpoint of the needs of nutrition and of metabolism, a definite individuality, and selects from among the principles which the blood places at its disposal those which are suited to it. Within its protoplasm it subjects them to a

series of processes, of constructive or destructive reactions. The sifting process which takes place on admission occurs also at the time of exit; the cell eliminates its wastes, but does not discharge indiscriminately into the circulating fluids all the products it has elaborated. There are some which it retains in its tissue; others it permits to exude, either continuously or at certain times.

"Everything that comes either from the digestive canal or from the various tissues is sifted before it enters the blood; everything that leaves this medium is likewise filtered, and it is in this way that due uniformity of distribution and balance of the functions are maintained.

"*But when some disturbance or other appears to compromise the preexisting harmony by allowing certain materials which normally have no access into the blood plasma to slip into it, one must expect that a corrective reaction will occur to purge the circulating fluid of these products which are foreign to it and should have remained so.*"

This corrective reaction may, under certain conditions and within certain limits, prove curative in respect of many states of instability of the blood. It is this practical aspect of the matter that the therapeutic endeavors now under way are trying to develop.

* * *

Again, the study of the manifestations of shock, and of anaphylactic shock in particular, led to the consideration of these manifestations as being dependent upon a loss of colloid balance in the blood—a *colloidoclasis* or *hemoclastic shock,* according to the expressive designation of Widal.

This loss of serum equilibrium or colloidoclasis, with the flocculations and secondary phenomena it induces, actually seems to be the proximal cause of conditions apparently as unrelated as the anaphylactic shock from food, drugs or serum therapy, urticaria, migraine, asthma, etc.

It was a logical proceeding to attempt to apply the stabilizing practices above mentioned to these conditions of serum instability. This is what clinical therapeutics is now engaged in, giving recognition, moreover, to those facts well established through colloid physical chemistry, *viz.,* that stabilization of colloidal complexes can be obtained by means of the most diverse substances, acting, according to the particular case, on the viscosity and osmotic pressure, the ionic dissociation of the solvent, the electric charge and size of the colloid particles, etc.

Actually, from the practical standpoint, innumerable clinical tests have already been carried out and interesting therapeutic results obtained. The most typical of these will be mentioned here; for the practical applications the reader is referred to the various sections of this work in which the treatment of the disorder in question is described.

Already in 1907 Besredka demonstrated the possibility of preventing the manifestations of shock, sometimes so serious, which follow an injection of serum, by preliminary injection of a very small amount of the same serum.

Many experimenters subsequently showed that one could sometimes obtain a desensitization of subjects hypersensitive to some substance or other (egg albumin, Besredka, Gurieff; antipyrin, Widal, Pasteur Vallery-Radot), through previous ingestion of an infinitesimal amount of the same substance. One must concede herein, however, at least in some measure, a specific prophylactic action.

This prophylactic action, in all likelihood an antiflocculant one, has been obtained under many circumstances without the possibility of invoking any specific action, and with a great variety of substances, both by the parenteral and the digestive routes.

Pagniez and Pasteur Vallery-Radot, through the preliminary ingestion of small amounts (0.5 gram—7½ grains) of peptone an hour before meals, obtained cures in many cases of *urticaria* and *migraine* refractory to all other forms of treatment.

Widal, Joltrain, Cordier and many other observers, with the same procedure, obtained very distinct relief in a few cases of *asthma* of digestive origin and of *hay fever.*

Sicard and Paraf have shown the prophylactic utility of previous intravenous injection of sodium carbonate, as advised by Kopaczewski, against *hemoclastic shock following intravenous injections of arsphenamin.*

Brodin has proven that the *immediate shock symptoms caused by intravenous injection of therapeutic serums* can be avoided by diluting these serums with 9 times their volume of an 0.8 per cent. solution of sodium chloride.

Widal succeeded, merely by injecting intravenously 30 c.c. (1 fluidounce) of isotonic salt solution, in preventing a return of the attacks in two patients with *rebellious asthma.* This was accomplished in these cases, however, only by bringing on "a shock of extreme intensity." It is important to note in this connection that "these were asthmatics, *i.e.,* individuals with an unstable plasmatic equilibrium and in whom any parenteral injection of foreign substances very easily provokes manifestations of colloidoclasis. Thus, in a woman suffering from angioneurotic edema,

intravenous injection of 1 gram of pure sodium carbonate did not check the urticaria, but it brought on a very severe shock." One thus sees, from the clinical standpoint, with what caution such therapeutic attempts should be made in these unstable subjects, who are precisely those in whom they are most indicated.

Autoserotherapy yielded some favorable results in the hands of Widal and his followers in *some cases of asthma* (due to egg), and in those of Achard and Flandin in hay fever and certain recurrent urticarias.

Autohemotherapy gave Ravaut frequent successful results in many skin disturbances and in diathetic disorders, urticaria, purpura, etc.

Intravenous injections of sodium thiosulphate, recommended by Lumière and Chevrotier, were found very useful in a few cases by Ravaut, notably yielding a cure in a case of recurring erysipelatous dermatitis.

The observations of Danysz relative to hypodermic injections of small amounts of bacterial proteins tend to promote recognition of the fact that the results of vaccine therapy are due in part at least to these stabilizing reactions.

* * *

The procedures just mentioned, almost purely clinical and to a certain extent empiric, are gradually giving way to systematic, methodical, accurate researches, involving application of the most exact procedures of physical chemistry, which, as is well known, has expanded most prodigiously in the course of the last two decades. An extraordinary transformation in biology and more particularly in pathologic physiology and in therapeutics may be expected from this new orientation. These branches will have to assimilate and adapt to themselves the acquisitions of physical chemistry. The physical chemistry of the colloids—while still very incomplete in many respects by reason of its incredible complexity, yet already well developed—has put many biologic questions in a new light and suggested many others for study. Agglutination, precipitation, flocculation, adsorption, stability and instability of the colloids form the basis of most of our diagnostic reactions (serum diagnosis, hemolytic reactions) and of many already established therapeutic practices. We should train ourselves to replace the prevailing logomachy of the "phenomenins" (precipitins, agglutinins, hemolysins, etc.), which is both puerile and obscure, by the necessarily concrete and often illuminating expressions of physical chemistry.

Mechanism of Fixation of the Complement (Bordet: "Immunité," p. 413).—Thus, Bordet brought out the view that fixation of the complement, instead of being, in conformity with the theory of complementophile grouping, a true chemical reaction obeying the law of chemical proportions, represents an instance of adsorption, comparable to the deposit of a coloring material on a solid object immersed in a fluid, or to the fixation of ferments or toxins by various precipitates or pulverulent materials such as animal charcoal, or again, to the phenomena of mutual aggregation of the particles of two colloids that are being mixed. According to this conception, just as the agglutinin, disturbing the adhesive relationships with the fluid, gives rise to flocculability, so the amboceptor, altering the contact properties of the antigen, would be supposed to lead to the appearance of adsorptive affinity toward the complement.

Complement is found in fluids in a rather unstable condition of equilibrium; it manifests a rather pronounced tendency to condense on appropriate materials, *i.e.*, materials which manifest a sufficient contact-affinity towards it. This kind of affinity, however, depends, as is well known, not only on the chemical nature of the substances concerned, but also, and perhaps even more strikingly, on their physical properties and in particular on their different states of colloidal division.

* * *

II. **Loss of Cell-colloid-serum Equilibrium. Hemoclastic Shock.**

The treatment of infectious diseases with colloidal agents soon led to the observation that the curative action was generally dependent upon a reaction exhibiting in a typical manner the manifestations of colloidoclastic shock, *viz.*, a febrile movement and a vascular and blood crisis. It was but natural, in consequence, to wonder, as did Widal, whether the process of colloidoclastic shock which can be brought on with a great variety of foreign substances—colloidal agents, peptones, bacterial vaccines, milk, various serums—could not be systematically employed as a therapeutic measure against infections.

The attempt to do this seemed all the more reasonable in that, as Bordet writes, natural immunity is accounted for mainly by the energy of phagocytosis, while the humoral properties in fresh animals are generally but slightly manifest.

Comparing two instances of pronounced immunity, the one natural, the other acquired, we find, in the one case, excellent phagocytes but relatively inactive body fluids; in the other, phagocytes of mediocre value in themselves, but which nevertheless, thanks to the

assistance of the principles in solution, carry out their task successfully.

The conditions existing in the two instances are thus not quite the same; the acquired resistance is not exactly identical, as regards its intimate *modus operandi,* with that which, in other species enjoying an inherent refractory state, forms part of the specific inheritance and is bound up with the actual constitution of the organism.

Therefore one could not but wonder, as did Widal, "whether the sudden modifications induced in the equilibrium of the plasma by injections of foreign substances could not exert a favorable influence on the course of certain diseases by bringing on a species of premature crisis."

A large number of clinical tests have been made, principally by Widal and his followers.

Autoserotherapy was tried by Widal in typhoid fever. The patient's own serum was injected intravenously after having been kept for sixteen to twenty-four hours in the incubator at 38° C., such incubation being intended to give the protein substances of the serum the heterogeneous properties necessary for the production of shock. A typical hemoclastic crisis, sometimes alarming, sometimes beneficial, with a marked chill, fever, low blood-pressure, heart acceleration and vomiting, was brought on in fifteen to thirty minutes. It is worthy of note that in the majority of the typhoid cases this procedure led to an immediate and sometimes permanent disappearance of the bacteriemia. On the whole, however, the clinical results remained dubious; the shock reaction may be alarming, so that, as Widal says, "in view of the impossibility of knowing beforehand the intensity of the shock produced, we have since then renounced the use of the method in a disease such as typhoid fever, in which the frequently precarious condition of the myocardium might lead to a dangerous situation."

Hemotherapy, autoserotherapy and ordinary serum therapy have been tried by a large number of clinicians in a great variety of disorders (influenza, pneumonia, septicemia, etc.) with the same inconstant results, sometimes excellent, at others definitely harmful. "The physician is not master of the shock reactions which he induces." (Widal.)

With intravenous injections of peptone Nolf obtained similar results in typhoid fever and in several cases of surgical septicemia.

There seems to be no doubt that, in part at least, the remarkable results at times obtained with many bacterial vaccines (see *Vaccine Therapy*) are dependent upon a primary shock caused by the bacterial proteins.

Similarly, aside from the specific action of antitoxic serums, an ordinary colloidoclastic action, often—in fact, too often—manifested in a serum reaction, may be invoked in the effect of such serums.

Like considerations apply, as is well known, in the case of intravenous injections of colloidal agents, apart from the varying degree of antiseptic action exerted by the metal used.

The above represents roughly, from the theoretic and practical standpoints, the data so far accumulated relative to the shock treatment of the infectious diseases.

The method is too uncertain as yet to be systematized for practical purposes. One cannot do better than recall Widal's own conclusions: "As for the treatment by shock, in spite of the strikingly successful results it is sometimes capable of yielding in the treatment of infectious diseases; in spite of its abortive power, which no other treatment can equal, it cannot, in my opinion, at present be given a place among the procedures of current practice; it is not systematically applicable to all cases of a given disease. The as yet unaccountable variability in its effects, the impossibility of foreseeing the intensity, sometimes extreme, of the resulting reactions, must cause its use to be reserved for exceptional cases in which all treatments have failed or the gravity of which warrants any sort of therapeutic attempt." (*Presse méd.,* Mar. 5, 1921.)

Alimentary Agencies.

DIETETICS.

The essentially practical general plan of this work precludes *a priori* all theoretic discussions, and it is unnecessary to recall how much dietetics has lent, is lending and will further lend itself to such discussions.

Limiting our presentation to that which is indispensable, we shall merely:

1. Summarize in a table based on data from various authors (Gautier, Alquier, Senalach, etc.) the *elementary composition and caloric value of various foods and beverages.* The accuracy of the data presented may be best described as "relative," as may easily be realized by inspecting the analytic tables contributed by different observers. The discrepancies are *a priori* inevitable. The disparity between the samples analyzed and errors of technic may make such discrepancies very pronounced. Alquier gives the caloric value of 100 grams of beef as 430 calories for the roast ribs and 179 calories for the shoulder. It is, therefore, advisable, while attempting to be as precise as possible, to recognize such data only in a general, approximate way. Thus it is well to know that gruyère cheese is a food practically devoid of carbohydrates and that its caloric value is, weight for weight, three times as great as that of veal, or that potato is nearly four times less nourishing than the same weight of dry vegetables; but the caloric figures, 400, 133, 100 and 347 which represent the caloric values of gruyère cheese, veal, potato and dried beans are merely rough indications permitting of an approximation to the truth—an approximation, however, which is more than sufficiently close for clinical purposes.

2. Group the foods according to their high or low content of given substances of major dietetic importance (proteins, carbohydrates, purins and nucleoproteins, sodium chloride, lime, phosphoric acid, cholesterin, etc.).

3. Present, by way of clinical application of the foregoing data, a few of the most commonly prescribed dietary régimes.

Furthermore, we shall have occasion to return to the consideration of these dietetic applications many times in the later course of the work.

4. Recall a few recent fundamental acquisitions relative to dietetic science.

It is well to train one's self to formulate a diet answering the several indications of a given clinical case in the same way as is done in writing pharmaceutic prescriptions.

REMARKS CONCERNING DIETETIC PRESCRIPTIONS.

FOODS OF HIGH PROTEIN CONTENT and among which are to be selected the components of a **diet high in proteins**: *Meats, eggs, fish, fowl, cereals, game, meat powders, meat extracts, meat juices.* Gluten bread. *Legumins* (beans, peas, dried beans, lentils). Cheeses: Edam, Gruyère, Roquefort, Cantal, etc.

FOODS OF LOW PROTEIN CONTENT, supplying the components of a **low-protein diet**: *Green vegetables, herbs, fruits:* Potato, rice, oats, kephyr, buttermilk; all beverages: wine, cider, beer.

FOODS OF HIGH CARBOHYDRATE CONTENT: *Cereals and starchy and farinaceous products, sugar and sweet foods:* Bread, lentils, beans, dried beans, chestnuts, peas, potato, rice, oats, barley, rye, pastes, noodles, macaroni, gnocchi, pastry, confections, chocolate, beer.

FOODS OF LOW CARBOHYDRATE CONTENT, supplying the components of a **hypoglycogenic diet**: *Meats, fowl, game, fish, eggs, crustaceans, shellfish, herbaceous vegetables;* mushrooms, celery, spinach, endive, asparagus, cabbage, salads, artichokes, tomatoes; dry wines.

FOODS OF HIGH NUCLEOPROTEIN AND PURIN CONTENT, **generating uric acid and xanthin derivatives**: *Viscera, meats (especially young meats such as veal and lamb), tripe, gelatin;* sweetbread, kidneys, liver, spleen, brains; chicken, rabbit; tea, coffee, chocolate, meat bouillon; fish and fish roe, salmon, caviar, etc.

FOODS OF LOW NUCLEOPROTEIN AND PURIN CONTENT, supplying the components of a **hypouricogenic diet**: *Leafy vegetables, salads, fat foods, fruits, milk and milk products;* potatoes, rice, cheeses, fresh cream; bread; strawberries, peaches, cherries, prunes, pears, grapes, oranges, tangerines, dates, walnuts, hazelnuts, almonds, etc.; dry wines.

CHEMICAL COMPOSITION AND CALORIC VALUE OF THE PRINCIPAL FOODS.

SALTS.	SODIUM CHLORIDE.	SUGAR.	CARBO-HYDRATES.		PROTEINS.	FATS.	NUCLEO-PROTEINS AND PURINS.	PHOS-PHORIC ACID.	CALORIES PER 100 GRAMS.
				Meats.					
	Per cent.		Per cent.		Per cent.	Per cent.	Per cent.	Per cent.	
—	1	—	0.5	Beef (with the fat).	17	29	0.24	0.35	339
—	—	—	—	Beef (without the fat).	21	2	—	—	100
—	—	—	—	Veal (with the fat).	19	7	0.28	0.45	133
—	—	—	—	Veal (without the fat).	20	1	—	—	198
—	—	—	—	Mutton (with the fat).	17	29	0.11	0.44	365
—	—	—	—	Pork (with the fat).	15	37	0.14	0.50	395
—	—	—	—	Pork (without the fat).	20	7	?	—	138
—	—	—	—	Goose.	16	46	?	0.40	230
—	—	—	—	Turkey.	25	9	0.15	—	181
—	—	—	—	Chicken.	23	3	0.15	—	120
—	—	—	—	Hen.	21	5	0.11	—	130
—	—	—	—	Rabbit.	23	2	Do.	—	120
—	—	—	—	Pigeon.	22	1	Do.	—	97
—	—	—	—	Hare.	23	2	Do.	—	163
—	—	—	—	Partridge.	25	1	Do.	—	110
—	—	—	—	Sweetbread.	28	0.2	1.20	—	115
—	—	—	—	Liver.	20	3.6	0 33	—	130
—	—	—	—	Kidneys.	18	8	High.	—	140
—	—	—	—	Heart.	18	2	Do.	—	190
—	—	—	—	Spleen.	17	4	Do.	—	100
—	—	—	—	Tongue.	15	17	Do.	—	210
—	—	—	—	Lung.	14	0.4	Do.	—	60
—	—	—	—	Brains.	13	16	Do.	0.35	220
—	—	—	—	Sausage.	22	40	Do.	—	450
—	—	—	—	Ham.	25	36	0.14	—	425
—	—	—	—	Meat powders.	70	6	—	—	330
25	—	—	—	Meat extracts.	28	—	—	—	110
9	—	—	—	Meat juice.	10	—	—	—	40
				Eggs.					
—	—	—	—	Entire egg.	7.4 (per egg)	5.7	—	—	153
—	—	—	—	White of egg.	4.5 (per egg)	—	—	—	—
—	—	—	—	Yolk of egg.	2.9 (per egg)	5.7	—	0.13	—
				Milk Products.					
Per 1000.			Per 1000.						
4.5	—	—	70	Asses' milk.	12	31		—	60
5.6	—	—	40	Goat's milk.	40	42		—	68
2	—	—	58	Woman's milk.	24	40	(traces.)	0.45	70
4.5	—	—	46	Cow's milk.	22	42		0.75	70
—	—	—	38	Kephyr No. 1.	38	22		—	50
—	—	—	20	" No. 2.	32	20		—	40
—	—	—	15	" No. 3.	12	20		—	30
0.5	—	—	5	Buttermilk.	1	0.3		—	3
				Cheeses.					
			Per 1000.		Per cent.	Per cent.		Per 1000.	
—	—	—	—	Roquefort.	25	30	—	—	404
—	—	—	—	Edam.	28	28	—	—	360
—	—	—	1.5	Gruyère.	30	30	—	—	400
—	—	—	—	Cantal.	25	34	—	0.45	410

CHEMICAL COMPOSITION AND CALORIC VALUE OF THE PRINCIPAL FOODS (*continued*).

SALTS.	SODIUM CHLORIDE.	SUGAR.	CARBO-HYDRATES.		PROTEINS.	FATS.	NUCLEO-PROTEINS AND PURINS.	PHOS-PHORIC ACID.	CALORIES PER 100 GRAMS.
				Fish.					
Per cent.	Per cent.	Per cent.	Per cent.		Per cent.	Per cent.	Per cent.	Per cent.	
—	0.45	—	—	Cod and Sturgeon.	18	1	—	0.48	76
—	—	—	—	Carp.	22	1	—	—	97
—	—	—	—	Sole.	19	2	—	—	83
—	0.40	—	—	Trout.	19	2	—	—	88
—	—	—	—	Salt cod.	27	0.3	0.04	—	110
—	0.46	—	—	Eel.	13	28	—	—	300
—	—	—	—	Eel (marine).	18	9	—	—	155
—	—	—	—	Salmon.	22	13	0.14	—	205
—	—	—	—	Herring (fresh).	15	9	—	—	140
—	—	—	—	Herring (salt).	19	17	—	—	250
				Fats and Oils.					
1.5	—	—	0.5	Butter.	0.7	84	—	—	750
0.55	—	—	4	Cream.	—	24	—	—	250
—	—	—	—	Lard.	1.1	94	—	—	344
—	—	—	—	Olive oil; peanut oil.	—	100	—	—	346
				Mollusks and Crustaceans.					
—	—	—	—	Crawfish.	18	1	—	—	80
—	—	—	—	Oysters.	9	1.5	—	—	50
—	—	—	—	Mollusks.	11	1	—	—	50
				Cereals and Legumins.					
—	1	—	55	Bread.	7	1	0.04	—	270
—	—	—	20	Gluten bread.	60	—	—	—	320
—	Per								
—	1000.								
8.5	1.65	—	59	Lentils.	23		0.07	1.10	337
3.5	0.56	—	57	Beans.	20	2	0.07	—	335
3	0.65	—	59	Peas.	21	1.5	—	0.92	335
2.5	0.40	—	55	Navy beans.	23	1	—	1.34	347
1	0.45	—	22	Potato.	2.5	1	0.002	0.16	190
1	0.04	—	77	Rice.	7	1	0	0.54	346
	0.22	—	65	Oats.	15	6	0.06	0.77	370
	1.6	—	70	Rye.	12	2	—	0.86	340
—	—	—	72	Barley.	11	1	—	—	330
—	0.74	—	38	Chestnuts.	5.5	1.5	—	—	160
				Other Vegetables.					
1	—	—	9	Carrots.	1	0.5	—	—	46
—	—	—	9	Turnips.	1	0.5	—	—	25
1	—	—	4	Celery.	1	—	—	—	20
1.4	—	—	32	Onions.	6	0.4	0.009	—	130
2	1.28	—	4	Spinach.	2	0.4	—	0.21	39
1	0.43	—	3	Salads.	1.6	—	—	—	20
1.5	—	—	6.5	Leeks.	3	—	—	0.20	40
1	0.92	—	5	Cabbage.	2	0.5	—	0.25	30
1	—	—	6	Brussels sprouts.	5	0.5	—	—	50
0.5	—	—	3	Asparagus.	2	—	0.02	—	20
—	—	—	2	Tomatoes.	1	—	—	—	15
—	—	—	1	Mushrooms.	6	0.3	—	—	36

CHEMICAL COMPOSITION AND CALORIC VALUE OF THE PRINCIPAL FOODS (*continued*).

SALTS.	SODIUM CHLORIDE.	SUGAR.	CARBO-HYDRATES.		PROTEINS.	FATS.	NUCLEO-PROTEINS AND PURINS.	PHOS-PHORIC ACID.	CALORIES PER 100 GRAMS.
				Fresh Fruits.					
Per cent.	Per cent.	Per cent.	Per cent.		Per cent.	Per cent.	Per cent.	Per cent.	
—	—	4.5	7	Peaches.	0.5	—	—	—	49
—	—	5	6	Apricots.	0.5	—	—	—	46
—	0.24	6	1	Strawberries.	0.5	—	—	—	30
—	—	7	5	Apples.	0.4	—	—	—	51
—	—	8	3.5	Pears.	0.5	—	—	—	50
—	0.03	3.5	4.5	Prunes.	0.5	—	—	—	51
—	0.14	10	2	Cherries.	0.7	—	—	—	50
—	—	24	2	Grapes.	0.6	—	—	—	78
—	—	4.6	3	Oranges.	0.1	—	—	—	30
				Dried Fruits.					
—	—	—	8	Raisins.	2.5	54	—	—	313
—	—	—	5	Figs.	4	50	—	—	248
—	—	17	17	Walnuts.	11	42	—	0.88	500
—	—	13	13	Hazelnuts.	15	62	—	—	675
—	—	0.5	0.5	Almonds.	6	2	—	—	641
—	—	6	14	Cacao.	15	47	—	—	—
				Beverages.					
		Per 1000	Per 1000.		Per 1000				
—	0.15	0.70	65	Beer.	5	—	0.01	—	45
	Per 1000.								
—	0.06	5 to 8		Dry wine.	—	—	trace	—	60
—	—	15 to 30		Sweet wine.	—	—	—	—	—
—	—	—	—	Tea.	—	—	0.12	—	—
		Per cent.	Per cent.						
—	—	54	14	Chocolate.	1.6	—	1.43	—	520
4	1.5	—	—	Bouillon.	7.5	—	1.3	—	—
—	—	—	—	Coffee.	—	—	0.50	—	—
				Various Saccharine Products.					
—	—	100	—	Sugar.	—	—	—	—	400
0.2	—	80		Honey.	1.3	—	—	—	320
2.20	—	54	14	Chocolate.	1.6	—	1.43	—	500
6	—	6	14	Cocoa.	15	47	—	—	556
1.8	—	72		Cookies.	11	9	—	—	400
1.6	—	75		Gingerbread.	6	3.6	—	—	352

FOODS OF HIGH SODIUM CHLORIDE CONTENT (to be avoided in chloride retention): *Meats, bouillons and meat extracts, fish, legumins, milk and its derivatives;* spinach, cabbage; oysters, mollusks and crustaceans; cheese, cow's milk and its derivatives; common bread and gluten bread.

FOODS OF LOW SODIUM CHLORIDE CONTENT and which should predominate in a **low-chloride diet**: *Fruits, starchy foods, beverages;* oranges, tangerines, bananas, figs, dates, grapes, peaches, cherries, strawberries, raspberries, apples, pears, apricots, prunes, currants, walnuts, hazelnuts, almonds; rice, oats, barley; dry wines, tea, coffee, chocolate.

APPROXIMATE CONTENT OF LIME IN FOODS. Reference is made to the foods most rich in lime, which are to be **avoided in phosphatic diatheses, deforming rheumatism, atheroma, arteriosclerosis, lithiases,** etc. Over 0.2 per cent.: cow's milk, cheeses, eggs, navy beans, cabbage, strawberries; 0.1 to 0.2 per cent.: asses' milk, lentils, beans, peas, cauliflower, garden vegetables, peaches; less than 0.1 per cent.: meats, brains, fish, potato, asparagus, apples, pears, prunes, cherries; less than 0.03 per cent.: wine and beer.

FOODS OF HIGH PHOSPHORIC ACID CONTENT, to be recommended in nervous depression, certain forms of demineralization (*phosphaturia*), etc.: *Cereals, fish, vegetables, meats, viscera;* bread and its derivatives, legumins, spinach, salads, leeks, yolk of egg, milk and its derivatives, cheeses.

FOODS OF HIGH CHOLESTERIN CONTENT, to be avoided in lithiases, *particularly in cholelithiasis:* Yolk of egg, brains, black pudding, sweetbread, calves' liver, kidneys.

FOODS OF LOW CHOLESTERIN CONTENT and which should predominate in **hypocholesterinemic diets**: Skimmed milk; vegetable foods in general, but particularly cereals, salads, leafy vegetables, fruits, a few legumins, especially in the fresh condition previous to full maturity.

* * *

The foregoing considerations are immediately applicable to the ordering of appropriate diets in cases in which the system is overloaded with mineral or organic substances, normal or abnormal, *i.e.,* in "retention diseases," whether production is excessive, or elimination deficient, or both of these conditions exist, as is frequently the case.

CALORIC VALUE OF 100 GRAMS OF VARIOUS FOODS.

Meats.	Number of Calories per 100 Grams.
Beef (ribs)	339
" (breast)	173
Mutton (breast)	365
" (ribs)	285
" (leg)	142
Veal (loin)	108
" (shoulder)	133
Pork (fresh ham)	118
Horse (filet)	123
Rabbit	120
Smoked ham	425
Sausage	450
Salt lard	486
Calves' liver	151
" brains	220
" kidneys	100
Pork (fat liver)	543
Black sausage	484
Fowl and Eggs.	
Chicken	220
Goose	230
Egg, entire	153
Fish *(fresh or preserved).*	
Smelts	76
Skate	95
Red mullet	112
Fresh sardines	114
Salmon	254
Sole	83
Trout	83
Mackerel	202
Fresh herring	116
Smoked herring	351

Game.	Number of Calories per 100 Grams.
Hare	163
Shellfish.	
Oysters	79
Fats and Oils.	
Butter	750
Cream	250
Lard	344
Cocoanut oil	753
Beef fat	830
Olive or peanut oil	846
Saccharine Products.	
Chocolate	500
Gingerbread	352
Cocoa	556
Cookies	400
Sugar	400
Honey	320
Starchy Foods, Dried Vegetables, etc.	
Bread	270
Dried lentils	337
Dried beans	335
Rice	346
Macaroni	347
Hulled dried beans	347
Dried peas	335
Chestnuts	190
Milk and Cheeses.	
Milk	70
Gruyère cheese	400
Camembert cheese	298
Brie cheese	306
Edam cheese	360

Fresh Vegetables.	Number of Calories per 100 Grams.
Artichokes (stalk)	70
Salads	15
Potatoes	79
Spinach	42
Yams	63
String beans	28
Asparagus	20
Carrots	46
Mushrooms	36
Turnips	25
Sorrel	29
Chicory	22
Cabbage	30
Cauliflower	37
Brussels sprouts	50
Fresh peas	78
Tomatoes	15
Fresh Fruits.	
Melon	19
Bananas	96
Apples	51
Grapes	78
Pears	50
Peaches	42
Cherries	60
Strawberries	30
Dried or Preserved Fruits, etc.	
Raisins	313
Dried figs	248
Dates	283
Prunes	306
Dry almonds	641
Hazelnuts	675
Walnuts	500

Retention of the xantho-uric products is certainly one of the determining factors in gouty and uricemic manifestations.

Retention of chlorides plays, as every one knows, a predominant rôle in the pathogenesis of nephritic and cardiac edema.

Retention of the bile pigments is the essential cause of the cholemic states.

Retention of lime salts seems, according to recent investigations, to be one of the provocative causes of arteriosclerosis and of certain forms of chronic rheumatism.

Retention of microbic and cellular toxins is one of the most important pathogenetic processes in a wide variety of infections.

In each particular case the principal dietetic indication will consist:

In the institution of a suitable **diet** calculated to reduce to a minimum ingestion of the foods generating the excrementitious substances with which the system is already overloaded:

Low-purin diet in manifestations related to the uric acid diathesis.

Low-chloride or **chloride-free diet** in cardiac and renal cases.

Low-nitrogen and antitoxic diet in cholemias, infections and toxemias.

Diet poor in lime salts in rheumatism and arteriosclerosis.

Typical diets for clinical use, formulated in conformity with the above data, will be found presented further on, but it seems advisable to recall beforehand a few additional important principles, which it is necessary always to have in mind in issuing dietetic instructions.

NORMAL DIETETIC REQUIREMENTS.

Modern investigations, taken collectively, have shown that for an average normal man weighing 70 kilograms (154 pounds), performing a moderate amount of work, the daily caloric requirements may be estimated at 3300 calories, *i.e.*, about 45 to 50 calories to the kilogram; the requirements in women are slightly less—about four-fifths of the requirements for males.

In a general way the carbohydrates and fats should predominate in the diet, and the amount of proteins can be distinctly reduced. Formerly, the minimal requirement of food proteins was placed at nearly 1.5 grams per kilogram of body-weight (the 100 grams of Voit and Pettenkoffer). The investigations of Richet and Lapicque lowered this figure to 1 gram and the more recent labors of the American school have again reduced it to 0.75 gram. Whatever other writers may have said, some subjects do not stand without harm a reduction below this amount. As a matter of fact, recent researches show that this food-protein factor is dependent upon the quantity and quality of the amino-acids, tryptophan and lysin in particular, which its disintegration may set free. For practical purposes, however, it is sufficient for us to bear in mind that 60 to 70 grams of food proteins are necessary for normal nutrition.

CALORIC VALUE OF VARIOUS FOODS PER 100 GRAMS

VERY HIGH CALORIC VALUE

- POTTED PORK 600
- ALMONDS 664
- BACON 620
- BUTTER 752
- OLIVE OIL 846
- ROQUEFORT CHEESE 464
- NUTS 600
- SAUSAGE 500
- CHOCOLATE 490
- BLACK PUDDING 484

HIGH CALORIC VALUE

- DRIED LENTILS 337
- MACARONI 347
- SUGAR 400
- RICE 346
- BROILED LAMB CHOP 380
- GRUYÈRE CHEESE 400
- DRIED BEANS 334
- COOKIES 400
- SARDINES IN OIL 246
- HARE PATÉ 320
- CAMEMBERT CHEESE 298
- DATES 300
- BRIE CHEESE 306
- BEEFSTEAK 308
- MACKEREL IN OIL 225
- CANNED SALMON 210
- FRIED POTATOES 250
- BREAD 270

MEDIUM CALORIC VALUE

- FRESH SARDINES 114
- HEN'S EGGS 171
- CHICKEN 200
- MULLET 108
- HAM 118
- HERRING 126
- RABBIT 120
- LEG OF MUTTON 142
- CHESTNUTS 154

LOW CALORIC VALUE

- POTATOES 90
- SOLE 88
- BANANAS 96
- SKATE 95
- MILK 70
- OYSTERS 79
- BEEF KIDNEYS 93
- STRING BEANS 50
- GRAPES 78
- WHITING 76
- CHERRIES 60
- APPLES 51
- SPINACH 50
- PEARS 51
- CARROTS 46
- ASPARAGUS 23
- TURNIPS 25
- CAULIFLOWER 37
- MUSHROOMS 39
- TOMATOES 17
- MELON 19

Recognizing, as has been customary, that the daily intake of carbohydrates should be in the neighborhood of 500 grams, the normal dietetic caloric schedule may be approximately stated thus:

Proteins	60 × 4 =	240 calories.
Carbohydrates	500 × 4 =	2000 calories.
Fats	120 × 9 =	1080 calories.
		3320 calories.

This caloric allowance, while theoretically well founded, *should be settled in actual cases only through observation and tests.* There are marked individual differences of efficiency in human organisms, and discrimination of these differences affords one of the soundest foundations of nutritive pathology.

The foregoing data must accordingly be always kept at hand and serve as a basis for the formulation of maintenance diets or of diets for purposes of reduction or hyperalimentation. Such data should be correlated with a few additional facts to be briefly recalled below, and in particular, applied in full knowledge of the disturbances of nutritive metabolism characteristic of the various morbid states.

ALIMENTARY ANAPHYLAXIS AND DEFICIENCY DISEASES.

Two features of dietetics that have long attracted attention and are of great practical importance have undergone some modification as a result of late investigations. The one relates to the toxic manifestations brought on in some individuals by the ingestion of foods which originally and under normal conditions had been well tolerated. By analogy with the manifestations described by Richet as resulting from the effects of poisons and of serums, these manifestations have been studied and designated as instances of *alimentary anaphylaxis.*

The second feature relates to the long-standing observation that a prolonged lack of fresh, raw foods in the diet brings on a series of disturbances formerly known by the general term scurvy. In recognition of the cause of these manifestations, *viz.,* the lack or absence of certain articles of diet which seem to be necessary for normal nutrition of the individual and the integrity of his functions, the diseases thus induced have been designated as *deficiency diseases.*

The essential facts relating to these two indispensable aspects of dietetics may now be very briefly considered.

ALIMENTARY ANAPHYLAXIS.—The following points are summarized from the writings of Laroche, Richet and Saint-Girons: Certain spoiled or toxic foods induce more or less serious symptoms of poisoning; these are food intoxications pure and simple, which belong in the ordinary group of the intoxications and are in no wise anaphylactic. Alimentary anaphylaxis consists essentially in the fact that a food well borne when ingested the first time, or which gave rise to only trifling disturbances, induces symptoms of increasing intensity on further successive ingestions. Alimentary anaphylaxis manifests itself only in certain individuals, and generally in a selective fashion for certain foods.

The **chief foods giving rise to anaphylaxis** are: Milk, eggs, raw or cooked meat, shellfish (lobster, crawfish, shrimps, oysters, mussels), and more rarely certain vegetable foods (strawberries, onions, beans, melons, pineapple, and prunes).

The **symptoms** are manifested in the form of:

Mild alimentary anaphylaxis: Urticaria, eczema, asthma, migraine, especially in children, manifesting intolerance of milk and eggs.

Severe alimentary anaphylaxis: Urticaria with severe itching, then major digestive symptoms of the toxic type (cramps, diarrhea, vomiting), and finally a general disturbance of varying severity which may reach a condition comparable to shock.

The last-mentioned manifestations require the same treatment as nervous shock: External heat, camphor in oil, ether, and adrenalin.

Either mild or severe anaphylaxis demands first a period of absolute starvation, water alone being allowed; then a period of cautious return to feeding with complete exclusion of all foods producing anaphylaxis, and a third period of gradual return to a normal diet, coupled, in the cases of severe anaphylaxis, with complete exclusion of the specific anaphylactic food, and in the mild cases, with at least temporary exclusion of the food followed by cautious attempts at resumption.

The physician should bear in mind in all cases that in infantile dietetics, and more particularly in dystrophic, premature or gastroenteritic children, any excess of food must be carefully avoided; he should especially beware of eggs, to which many children are sensitized.

DEFICIENCY DISEASES.—The observed facts are as follows:

Certain exclusive diets of fresh foods cause special diseases: Scurvy of the adult, infantile scorbutus (Barlow's disease), beriberi and pellagra.

A diet which is perfect from the chemical standpoint, *i.e.*, which contains normal proportions of water, mineral salts, fats, carbohydrates and proteins, but which has been completely sterilized, brings on scorbutic symptoms; this applies, for example, to the exclusive feeding of an infant with perfectly sterilized milk. Let some fresh foods, such as fruits or fruit juices be added to this diet, and the symptoms disappear. Lemons have long had a reputation as an antiscorbutic among the members of polar expeditions and the inhabitants of besieged cities.

Hens fed exclusively on hulled rice soon exhibit symptoms of polyneuritis similar to those of beriberi; if unhulled rice is restored to them, they recover.

Rabbits receiving exclusively sterilized grass, cabbage and beets rapidly develop scorbutic symptoms; addition of fresh grass, cabbage and beets to their diet causes the symptoms to disappear.

Thus, the sterilization of the food or decortication of the rice has destroyed or caused to disappear some substance indispensable to normal nutrition. What is this substance? In this connection two highly suggestive explanations have been advanced.

The Vitamins.—The lacking vital principles or vitamins are described as chemical substances allied to the pyrimidin bases which enter into the composition of nucleinic acid; they are [some of them] destroyed or decomposed at 110-120° C., and are indispensable to the system, which is, however, unable to build them up.

Funk isolated a vitamin and gave its formula as:

$$\begin{matrix} NH \\ | \\ CO \\ | \\ NH \end{matrix} \Big> C_{16}H_{18}O_6.$$

A few milligrams of it proved sufficient to cure birds suffering from experimental beriberi. Several vitamins, corresponding to certain groups of foods, have been described. In short, the deficiency diseases are thus held to be instances of *avitaminosis*.

Theory of the Symbiotes.—The intracellular mitochondria enclosed in all living cells may be considered as micro-organisms living in close symbiotic relationship with the cells themselves, to the life of which they are indispensable, whence the term *symbiotes* applied to them by Portier, the sponsor of this theory. The symbiotes are regarded as indispensable to the processes of cell nutrition, particularly those of a synthetic character.

The symbiotes are destroyed by a temperature of 110-120° C. Addition to a deficiency diet of living, isolated symbiotes prevents the symp-

toms or causes them to disappear. In short, according to this view, the deficiency diseases are *asymbioses.*

* * *

The chief practical conclusion to be borne in mind is that which emphasizes *the danger attending the long-continued use of stringent, systematic diets.* On theoretic grounds it was believed for a time that the formulation of a dietary régime reduced itself to a calculation of caloric values and that the various foods were interchangeable; this is a great and most deplorable mistake. Then it appeared to others, on the basis of abuses of nitrogenous food—which actually did occur—that dieting had as its main aim an extreme reduction in the amount of nitrogenous articles ingested. Who can count the number of disasters resulting from this system? The murderous effects of infantile scurvy proved necessary to convince many an exponent of child welfare that *diet* and *antisepsis* must not be confounded. Even such a valuable measure as the chloride-free diet; when too strict or too long continued, is capable of causing serious physical impairment.

There are three types of mind: The narrow type, capable of seeing only one factor in a problem; the versatile type, capable of distinguishing several factors, but only consecutively (many of the predominantly analytic minds are of this type), and the synthetic type, capable of encompassing at one time the complexity of a phenomenon, its various component factors, and their mutual relationships. Let us endeavor to train ourselves in this third form of mental discipline.

Coming back to the deficiency diseases, it should be kept in mind that these diseases are particularly to be feared in childhood, and that, on the whole, it is to Sir Thomas Barlow that redounds the credit of having, some thirty years ago, ascribed infantile scurvy to its true cause, *viz.*, the exclusive use of sterilized milk and the absence of fresh foods. The scurvy of adults originates, indeed, in the same way: Exclusive and prolonged use of sterilized, preserved foods, such as smoked meats, salt and dried fish, canned foods and sterilized milk. It is much less common, however, than infantile scurvy. In this connection the following note of Lopez-Lomba and Portier (*Académie des sciences,* June 27, 1921) seems suggestive:

"Adult rabbits withstand indefinitely food sterilized at a high temperature, owing to the fact that the bacteria which normally develop in their lymphoid tissues supply the vitamins which the diet has failed to bring in.

"In the young growing rabbit, this source of vitamins being inadequate, the younger the animal, the more rapidly he succumbs."

The following constitutes, according to Comby (*Presse méd.*, July 23, 1921), the proper *treatment for a case of infantile scurvy:*

"**Treatment.**—1. Withdrawal of the preserved food: sterilized, condensed or dried milk, etc. It should be replaced by raw, aseptic cow's or goat's milk, or milk that has merely been boiled. If the child takes pap, it should be prepared with natural flour and fresh milk.

"2. To accelerate the disappearance of the scorbutic symptoms, the child should be given daily, one hour before or after the bottle, 2 or 3 teaspoonfuls of orange juice or grape juice. If these fruits are not available, lemon juice diluted with sweetened water may be substituted.

"3. When the older child (18 months to 2 years) is beginning to eat, fresh vegetables should be ordered, including mashed potato and cooked salads. Raw meat and raw meat juice are not indicated.

"4. In later childhood, in subjects from 4 to 10 years of age, scurvy is sometimes seen as the result of too uniform a diet, *e.g.*, one of food pastes, gruels, starches with sugar, and farinaceous articles cooked to excess. An exclusive diet of this sort, continued for a long time for fear of enteritis, should be replaced by a more rational one including soups, fresh vegetables, roasted or grilled meats, etc. The scurvy will then disappear.

"5. A child suffering from scurvy should not be moved about, bathed, nor rubbed; one should be satisfied with plenty of fresh air and rides out-of-doors. The customary measures of personal hygiene may be resumed when the pain has disappeared.

"**Prophylaxis.**—1. To prevent scurvy in bottle-fed infants receiving sterilized milk of any sort, one should make it a practice to give on an empty stomach, at a time remote from the use of the bottle, a teaspoonful, dessertspoonful or tablespoonful, according to age, of the juice of a completely ripe orange.

"2. When a choice of the milk to be used can be made, preference should be given to plain boiled milk over sterilized, superheated, or otherwise modified milk. One should not wait for the major symptoms of scurvy (paralysis of the extremities, pain on manipulation, bleeding gums) to appear before changing the diet. As soon as the baby ceases to thrive, becomes pale and peevish, and refuses the bottle, orange or grape juice should be given, and a miraculous restoration of health in a few days will be witnessed."

SOME FREQUENTLY USED DIETS.

Applying to a few concrete types of clinical cases the fundamental dietetic data already presented, we shall formulate hereinafter a number of dietary prescriptions.

It lies within the field of the practitioner, on the basis of his personal experience, to train himself to prescribe a diet both quantitatively and qualitatively in a manner as well thought out as a pharmaceutic prescription. It should be borne in mind that in the treatment of chronic disorders, diet and physical therapy are of far greater significance than drug treatment.

I.

Following is a **mitigated milk diet** particularly suitable, at least temporarily, during the acute exacerbations or in the subacute stage of **cardio-renal disorders,** especially in *nephritis:*

Articles Allowed:

Milk and milk products.—Milk soups.—Tapioca, vermicelli, rice, with milk.—Mashed potatoes with milk.—Cooked fruits, marmalade, jam.—Raw fruits (peaches, grapes, oranges, tangerines, etc.).—Dry cakes, crackers.—Water, simple infusions.

Approximate Daily Amounts:

Milk: 1 to 1½ liters (quarts).
A few tablespoonfuls of tapioca or vermicelli.
100 to 200 grams of potatoes (weighed raw).
Eight dry wafers of the Palmer type.
Two oranges or four tangerines, or two peaches, or two bunches of grapes.
Two tablespoonfuls of jam or marmalade.
One-half liter (1 pint) of water or infusion.

Typical Menu:

7 a.m. Milk soup or pap.
9 a.m. Fresh fruit (bunch of grapes, strawberries, or an orange).
11 a.m. Milk soup.
Mashed potatoes with milk.
Jam.
Crackers, saltless.
Infusion.
4 p.m. Fresh fruit (peach, grapes or orange).
5 p.m. Milk soup.
Mashed potatoes with milk.
Jam.
Crackers, saltless.
Infusion.
8 p.m. Milk soup or pap.
Fresh fruit.
One cupful of sweetened milk in the night.

In adults there is nearly always advantage in avoiding a stringent milk diet and in replacing it by mitigated milk or vegetable and fruit diet of the preceding type, for the following reasons:

1. Milk, while clearly sufficient for the needs of the newborn infant and young animals, to which it supplies the salts necessary for growth, is much too rich in calcium for the requirements of the adult (1.5 per cent. of calcium in the dry extract).

2. As a matter of fact, an exclusive milk diet causes in the adult a manifest retention of lime salts (Rumpf, Hirsch, Terray); calcium balance is restored by the combined use of cellulose (vegetables) and of fruits, particularly lemons.

3. A strict milk diet induces fecal stasis and constipation.

4. To afford a maintenance diet, about 3 liters of milk are required, which is altogether contraindicated in cardiorenal cases.

II.

The so-called **Karell diet**, valuable during the *acute attacks of heart weakness in* **heart disease,** is essentially a *milk diet with marked reduction in amount.*

It may be very simply ordered, thus:

Take in the twenty-four hours 800 c.c. (to 1 liter) of milk (preferably skimmed) in four portions of 200 to 250 c.c. each at regular intervals, *e.g.,* at 8 a.m., 12 m., 4 p.m. and 8 p.m.

The milk may be taken either hot or cold, with or without addition of sugar, and, if necessary, flavored with a tablespoonful of tea or coffee.

It should be taken slowly, by teaspoonfuls, in the course of eight or ten minutes.

The diet should not be continued, except in rare instances, longer than five days at the most.

Absolute rest in bed or on a couch or armchair should be ordered while the diet is being followed.

Hot water bags may be placed at the feet if required.

III.

A **diet** which may be suitable in the **subacute or chronic stages of enteritis:**

Articles Allowed:

Gruels.—Barley, oats, tapioca, rice, etc.

Soups.—Purées of vegetables, strained, with or without butter; vegetable broth.

Food pastes.—Noodles, macaroni, gnocchi, with or without eggs.

Soups made with these products; bread soup in water, in vegetable broth, cooked with salt water or vegetable broth, with or without addition of fresh butter before serving. Rice in vegetable broth.

Milk products.—Clotted milk, kephyr, yoghurt, fresh butter.

Vegetables.—Peeled dry vegetables in a purée. Mashed or baked potatoes. Fresh vegetables in a purée, strained.

The vegetables should be cooked in salt water and fresh, uncooked butter added before serving.

Fruits.—Cooked fruits in marmalade or compote, strained through a strainer or cloth.

Jams, fruit jellies, honey.

Meats.—Filet of beef, mutton, veal. Lean ham, smoked tongue.

Meats should be taken in moderate amounts and at but one meal a day. They should be well done, broiled, roasted, or braised, without sauces or with their own gravy from which the fat has been removed.

Fish: River fish, lean: Trout, perch, etc. Sea fish, lean: Sole, smelts, cod, turbot, etc. These may be cooked with a special gravy or broiled with or without butter. No cooked butter should be used.

Fowl.

Puddings.—Rice, tapioca, semolino, etc.

Cheeses.—Gruyère, Swiss, etc. No strong cheeses.

Pastry.—Cookies, small tarts.

Bread.—Stale or toasted; crackers of various kinds.
Beverages.—Water or infusions.

Articles Forbidden:

Sauces, fats, cooked butter, fried foods, ragoûts.
Eggs, brains, viscera.
Milk, except in the forms above specified.
Sausages and other meat products, canned meats, shellfish, game.
Mushrooms, cabbage, sorrel, tomatoes.
Spices, condiments, rough and acid foods.

IV.

Diet suitable for ordinary and continued use in most case of **dyspepsia, cholemia and lithiasis.**

Articles Allowed:

Lean or milk soups.
Meats: Red (beef, mutton), white (veal, fowl) or gelatinous (calves' head and feet, lambs' feet, well cooked), in very moderate amount, 200 grams at most.
Lean ham, smoked tongue.
Boiled lean fish (sole, whiting, sunfish, etc.).
Fowl, except goose and duck.
Fresh vegetables (peas, string beans, carrots, asparagus, artichokes, salsify, cooked salads, leafy vegetables).
Potatoes.
Starchy foods, paste foods and cereals.
Sweet fruits, thoroughly ripe.
Bread (in limited quantity).
Milk, preferably skimmed, and milk products; fresh cheeses.
Beverages: Water, infusions.

Articles to be Especially Avoided:

Fats and fat meats (pork, goose, salmon, mackerel, eels, sauces, ragoûts, fried articles, etc.).
Acids: Vinegar; insufficiently ripe fruit; sorrel, cruciferous plants, cabbages, turnips, radishes, etc.
Spices; gamy, softened, salted or preserved meats.
Indigestible foods, shellfish, onions, raw vegetables, mushrooms, truffles.

Viscera, kidneys, sweetbread, calves' liver. } To be particularly forbidden in lithiasis.
Alcoholic beverages, chocolate.
Eggs, brains.

Culinary Remarks:

Meats, fowl.—To be broiled or roasted without sauce; well-done.
Fish.—Fresh butter and lemon juice to be added before serving.
Vegetables.—Boiled, with addition of fresh butter and lemon juice before serving.
Fruits.—Cooked with very little sugar, or raw if thoroughly ripe.
Thick soups.—Purée of vegetables, strained or with milk.

Typical Menu:

Morning:

Coffee with milk, sweetened with honey, and crackers or toast.

Noon:

12 m. Main meal.
(*a*) One chop.
(*b*) One helping of potatoes.
(*c*) One fresh vegetable.
(*d*) Well-ripened fruit (one).
(*e*) Dry bread.
(*f*) Water or hot infusion.

Dinner:

6.30 p.m. (*a*) Lean soup.
(*b*) Fish or a little fowl.
(*c*) Fresh vegetable.
(*d*) Fresh cheese.
(*e*) Bread.
(*f*) Water or hot infusion.

Evening:

9 or 10 p.m. A cup of hot infusion.
At night, if necessary, a large cupful of hot, sweetened milk with or without addition of water.

General and Special Remarks:

Eat slowly and quietly, at regular hours; masticate thoroughly; cut the meat into very small pieces; crush the vegetables.

Rest in recumbency after meals.

Gilbert frequently orders a *four-meal régime,* which is much more stringent than the preceding one.

This diet is indicated in various forms of dyspepsia, in familial cholemia, in various hepatic disturbances, etc.

Four meals a day are taken, at 8 a. m., 11 a. m., 5 p. m., and 8 p. m.

First and third meals: ¼ to ⅓ liter of milk.

Second and fourth meals: Soup or milk broth, ⅓ to ½ liter, with salt or sugar (flour, tapioca, vermicelli; various forms of flour, except those containing chocolate or made from chestnuts); 1 to 3 tablespoonfuls of a strained purée of vegetables, or of rice and milk, with salt or sugar; 1 to 3 dessertspoonfuls of cooked, peeled and strained fruits, or 1 to 3 teaspoonfuls of fruit jelly (avoiding the acid fruits—currants, raspberries or oranges); 1 to 3 fingerbreadths of bread crust; ⅓ to ½ liter of milk as beverage.

The milk should be skimmed (except that used in the preparation of the vegetables).

Fifteen minutes should be consumed in taking the smaller meals and one hour for the larger ones. Rest in recumbency after meals is ordered. The patient may rise, go out and walk in periods sufficiently remote from the meals, *viz.,* from 9 to 11 a. m., 2 to 5 p. m., and 6 to 8 p. m. Suppositories, enemas or irrigations are to be used, if necessary.

V.

Diet of low calcium content which may be appropriate in **arteriosclerosis** in the stage of cardiorenal compensation.

Articles Allowed:

Lean or milk soups. Butcher's meats (beef, mutton, veal, exceptionally). Fresh water fish (trout, carp, etc.), except salmon and eels. Sea fish (sole, turbot, smelts, etc.). Fowl. Rabbit. Milk.—Cheese. Legumins (dried beans, lentils). Green vegetables (lettuce, cooked chicory, green peas, string beans).	*At one meal only, in very limited amount, 80 to 120 grams.*

Eggs, one or at most two.

Potatoes, carrots, rice, macaroni, noodles, sweet potatoes, turnips, salsify.

Curdled milk, 120 to 150 c.c.

Raw fruits: Oranges, grapes, strawberries, raspberries, currants, cherries, plums, pears, apples.

Cooked fruits: Preserves, marmalades, jellies, compotes.

Cookies, small tarts.

Puddings, rice cakes.

Beverages: Water, orangeade, lemonade.—Aromatic infusions.—Cider.

Bread: Toasted, or soft crust (100 grams at most).

Articles Forbidden (or at least to be avoided):

Salt and salty foods.

Fats, sauces, ragoûts and fatty foods.

Mushrooms, sorrel, spinach, truffles.

Viscera, game, shellfish, pork products, canned meats, fermented cheeses.

Chocolate, cocoa, champagne.

Culinary Remarks:

Meat and fowl.—Broiled or roasted, without sauce.

Fish.—Fresh butter and lemon-juice to be added before serving.

Eggs.—Preferably boiled or poached, or yolks of eggs alone.

Vegetables.—Boiled, with fresh butter and lemon-juice added before serving.

Salads.—Cooked or raw, very tender, seasoned with but little salt and preferably lemon juice.

Fruits.—Cooked with very little sugar, or raw if thoroughly ripe.

Thick soups.—Purées of vegetables, strained or with milk.

Amounts:

Meat, fowl and fish.—At one meal only.

Eggs.—One or at most two.

Milk.—200 c.c. at most, preferably curdled milk.

Bread.—100 to 120 grams.

Vegetables.—In moderation.

Salt.—Two to four grams at most.

Beverages.—One liter at most.

Soups.—One-half plateful.

Typical Menu:

7 a.m. Milk with coffee (120 c.c. of milk with 2 tablespoonfuls of coffee) and crackers.

9.30 a.m. Tumblerful of water (200 c.c.), plain or with addition of the juice of one-quarter of a lemon or (in season) of a bunch of grapes.

11.30 a.m. One chicken wing, or fish, or a chop.
Potatoes, carrots, or beans.
Cookies, fruit marmalade, or curdled milk.
Toast.
One tumblerful of water (200 c.c.) with 2 tablespoonfuls of white wine.

6 p.m. Lean soup made with strained vegetables, with little salt.
One boiled egg.
Two tablespoonfuls of rice.
One orange, grapes or cherries.
150 c.c. of water with 2 tablespoonfuls of white wine.

8 p.m. One cup of hot infusion (linden, orange leaves or verbena).

General and Special Remarks:

Eat slowly and quietly, at regular hours; masticate thoroughly; cut the meat into very small pieces; crush the vegetables.

VI.

As a counterpart of the foregoing hypocalcic (demineralizing) diet, following is the plan of a **hypercalcic (remineralizing) diet,** based on the views of Perrier (administration of calcic foods and exclusion of acid, anti-calcic foods), and which may be suitable for **tuberculous patients** and in general for subjects in whom restoration of mineral substances is indicated (**wet-nurses, rachitic cases, puny children,** etc.).

Soups.—Purées of vegetables, strained and with cereal flours (wheat, barley, oats, etc.).

Lean ham, smoked tongue, oysters.

Meats.—Preferably red meats; lean or with fat removed, preferably broiled.

Fish.—Oily fish to be avoided; no fried fish.

Fowl.

Food pastes.—Macaroni, noodles—all are serviceable. Avoid excess of butter in seasoning.

Dry vegetables.—Preferably in purées. Rice, beans, lentils, chestnuts.

Green vegetables.—Avoid acid vegetables (sorrel).

Cheeses.—Camembert, Gervais, Brie, Gruyère, Edam.

Salads.—To be excluded completely.

Fruits.—To be eaten cooked; avoid acid fruits, especially oranges and lemons.

Bread.—To be taken in moderation; preferably the crust. Special, highly fermented breads to be avoided. Bread soups to be disallowed and replaced by soups with pastes, flour, vegetable purées, cream of rice, etc. Skimmed bouillon should alone be used.

Beverages.—Interdict wine and cider. The patient should drink water, preferably such as contains lime, or beer, 1½ glasses at each meal.

Tea and coffee.—In moderation.

VII.

The following is a rather liberal **reduction diet**, which may be suitable in many cases of **obesity, plethora, well-compensated heart disease, uricemia, lithiasis** or **gout** (in the intervals between attacks).

Articles Allowed:

Hors-d'œuvre.—Lean ham, smoked tongue, oysters, radishes, celery.

Meats.—Preferably beef or mutton, exceptionally veal or pork.

Fowl.

Lean fish.—Sole, flounder, smelts, perch, trout, etc.

Eggs.

Fresh vegetables.—Potatoes, carrots, celery, beets, salsify, artichokes, egg-plant, tomatoes.

Green vegetables and salads.—String beans, raw or cooked salads (endive, chicory, dandelion, corn salad, etc.).

Fresh fruits.—Apples, pears, peaches, grapes, apricots, strawberries, raspberries, currants, oranges, tangerines, fresh figs.

Biscuits.

Bread.—Toast or soft crust.

Beverages.—Water, tea, coffee, infusions, cider.

Milk and *milk products.*

Articles Forbidden (or at least to be avoided):

Salt and salted foods.

Sugar and sweet foods: Preserves, desserts, pastry, confections.

Fats, sauces, ragoûts and fatty articles.

Starchy foods, flours, pastes (including beans, lentils, chestnuts, rice, noodles, macaroni, etc.).

Mushrooms, sorrel, spinach.

Viscera, game, shellfish, pork products, canned meats, fermented cheeses.

Chocolate, cocoa, champagne, Burgundy wine.

Culinary Remarks:

Meat, fowl.—Broiled or roasted, without sauce.

Fish.—With addition of fresh butter and lemon juice before serving.

Eggs.—Preferably boiled or poached, or the yolks alone.

Vegetables.—Boiled, with fresh butter and lemon juice added before serving.

Salads.—Cooked or raw, very tender, seasoned preferably with a little salt and lemon juice.

Fruits.—Cooked with very little sugar or raw and thoroughly ripe.

Thick soups.—Purée of vegetables, strained or with milk.

Amounts:

Meat, fowl, fish.—At most 150 to 200 grams.

Eggs.—One or at most two.

Milk.—200 to 250 c.c.

Bread.—100 to 150 grams.

Vegetables.—*Ad libitum.*

Salt.—At most 3 to 6 grams.

Beverages.—Altogether 1½ liters, more or less.

Soups.—Little (one-half plateful), or better, none.

VIII.

Salt-free diet, to be ordered in a more or less strict and prolonged manner in **hydropigenous chloridemic nephritis** and generally in cases with **chloride retention.**

Articles Allowed:

Lean or milk soup, *without salt.*

Beef, mutton or pork, raw, broiled or roasted, ***without salt.***

Roast fowl, chicken or turkey, ***without salt.***

Rabbit.

Fresh water fish, ***without salt.***

Fresh eggs, raw or boiled, ***without salt.***

Potatoes *without salt,* boiled or baked, or sauté in butter, or mashed.

Rice, peas with butter or sugar, carrots, leeks, chicory, string beans, celery, artichokes, salads cooked without salt.

Sweetmeats, pastry, *without salt.*

Raw or cooked fruits (preserves, marmalade, compotes).

Milk and milk products.

Fresh butter, fresh cream, cheese *without salt.*

Chocolate, tea, coffee.

Bread or *saltless* crackers.

Beverage: 1 to 1½ liters, water or infusion.

NOTE.—The sauces and seasonings should be prepared *without salt,* using as required meat jelly (prepared without salt), thyme, tarragon, laurel, onion, parsley, lemon, flour, butter and yolk of egg.

Typical Menu:

8 a.m. Coffee with milk and sugar, *saltless* crackers, honey and butter.

12 m. (*a*) Lamb chop, broiled or roasted, *without salt.*
(*b*) Sauté potatoes with butter, *without salt.*
(*c*) Peas with butter and sugar, *without salt.*
(*d*) Cream cheese, *without salt.*
(*e*) *Saltless* bread.
(*f*) One tumblerful of water or beverage (200 c.c.).

4 p.m. Tea with milk and sugar (200 c.c.), bread dried by heat.

7 p.m. (*a*) Tapioca with milk, *without salt.*
(*b*) Boiled eggs, *without salt.*
(*c*) Carrots with meat jelly, *without salt.*
(*d*) Fruits in season (peach, grapes, orange).
(*e*) *Saltless* bread.
(*f*) One tumblerful of water or beverage (200 c.c.).

Following are *three other specimen salt-free menus* (ACHARD and PAISSEAU):

I.

Breakfast.
Weak coffee or tea.
Crackers.

Lunch.
Pork chop, broiled.
Mashed potatoes.
Fruit compote.
Saltless bread, 100 grams.

Dinner.
Bread soup.
Noodles with butter.
Creamed chicory.
White cheese.
Bread, 200 grams.

II.

Breakfast.

Coffee with milk.
Crackers and butter.

Lunch.

Roast chicken.
Baked potatoes.
Carrots with butter
Preserves.

Dinner.

Gruel.
Boiled egg.
Purée of lentils.
Mush.

III.

Breakfast.

Chocolate and crackers.

Lunch.

Roast filet of beef.
Purée of peas.
Vegetable salad.
Fruit compote.

Dinner.

Cream soup.
Fried trout.
Cream of lettuce.
Pastry.

IX.

Diet very low in carbohydrates, applicable with changes (addition or prohibition) dictated by experience, in cases of **major glycosuria** free of all toxic manifestations (particularly those of acetonemia) and with good cardiorenal compensation.

Solid Articles:

Allowed Unreservedly.—Of animal origin: All meats (beef, mutton, veal, lamb, pork, etc.).—Smoked meats (ham, tongue).—Pâtés, discarding the crust.—Fowl (chicken, pigeon, partridge, goose, turkey, etc.).—Rabbit, fresh game.—Fish of any sort.—Oysters.—Shellfish.—Eggs in all forms, except with flour or sugar.—Cream, butter, cheese.

Of vegetable origin.—Spinach, lettuce, endive, chicory, celery, raw or cooked salads, Brussels sprouts, water-cress, asparagus.—Walnuts, hazelnuts, almonds, olives.

Allowed with Reservations, i.e., in moderate amount and under medical supervision.—Cabbage, cauliflower, sauerkraut, turnips, radishes, potatoes, string beans, sweet potatoes, artichokes, mushrooms, salsify, tomatoes.—Whortleberries, oranges, strawberries, cherries.—Bread according to directions given.

Absolutely Forbidden.—Rice, tapioca, sago.—Cereal gruels and flours.—Pastes, corn.—Peas, beans, lentils, chestnuts, beets, carrots, onions.—Pastry, cakes, confections, sweet foods.—Grapes, dates, figs, plums, peaches, melons, marmalades and preserves.

Liquid Articles:

Allowed Unreservedly.—Water.—Infusions (tea, coffee).—Wines.—Meat or chicken broth.

Allowed with Reservations.—Milk, unsweetened almond milk, lemonade without sugar.

Absolutely Forbidden.—Beer, cider, champagne, sweet wines, syrups, chocolate, sweet beverages.

Typical Menu:

Morning. Coffee without sugar, but with cream.

Noon.
(*a*) One or two eggs with ham.
(*b*) Broiled or roasted meat, or fish.
(*c*) Green vegetables (spinach, cabbage, celery, salad).
(*d*) Walnuts, almonds, hazelnuts, or cheese (Gruyère, Edam, Brie), or white cheese.
(*e*) Potatoes (100 grams) instead of bread.
(*f*) Beverage: Water, with or without wine.

4 p. m. Tea without sugar but with cream.

Evening.
(*a*) One plateful of bouillon, or hors-d'œuvre (filet of herring, sardines, smoked tongue, olives, oysters).
(*b*) Meat or fowl, or fish (same as noon meal).
(*c*) Green vegetables (same as noon meal).
(*d*) Dessert (without sugar) flavored with vanilla or coffee, or half an orange.
(*e*) Potatoes (same as noon).
(*f*) Beverage (same as noon).

Culinary Remarks:

No flour or sugar should be used in the preparation of the food.

For sauces and seasonings one may use water, meat bouillon, butter, egg yolk, fats, oil, spices, parsley, tarragon, chervil, cloves, etc.

For desserts: Eggs, cream, almonds, gelatin, and lemon.

The sugar should be replaced by glycerin or saccharin.

X.

The **fruit diet** is the **lowest in nitrogen compounds and chlorides** known with the exception of actual restriction to water with or without lactose, and is, therefore, extremely serviceable, at least temporarily, in most cases of **hepatico-renal insufficiency, auto-intoxication, azotemia, chloridemia,** and **uricemia,** *especially in the nephritides.*

It is often much more acceptable to the patients than the milk diet, which to some becomes irksome to an almost intolerable degree. I prescribe it regularly once or twice a week in most of my chronic cases: Plethora, gout, azotemia, uricemia, lithiasis, cholesterinemia, high blood-pressure, etc.

It is very simply ordered, thus:

Raw fruits: Peaches, grapes, oranges, tangerines, bananas, cherries, strawberries, raspberries, etc.

Cooked fruits: Marmalades, compotes, preserves, jellies.

The *grape cure* is merely a variation, which is often serviceable and to be recommended. Either the whole grapes or grape juice (sterilized, if need be) may be prescribed in increasing amounts of 500 to 2000 grams or more.

In a general way, the following effects from fruit cures may be expected:

1. Increased diuresis with reduction of urinary acidity.
2. Increase of chlorides and of urea in the urine and in consequence, diminution of chloridemia and of azotemia.
3. Stimulation of the functions of the liver and kidneys, frequently resulting in laxative and detoxicant effects.

It should not be forgotten that this diet is a reduction diet, which is quite insufficient for supplying the nutritive requirements in the long run, and which should be instituted only temporarily and under supervision (weight, blood-pressure and urine).

This diet lends itself to numerous combinations and variations.

Even the mere addition of oily fruits, such as walnuts, filberts, almonds and olives, will markedly increase in nutritive and heat-forming values.

It may very readily be combined with milk, certain vegetables, pastes and cereals, as in the following rather liberal diet, which may be continued almost indefinitely if required.

Milk, vegetable and fruit diet.

Articles Allowed:

Milk and milk products, tea or coffee with milk.
Milk soups, onion soup with milk.
Tapioca, vermicelli, rice with milk.
Mashed potatoes with milk.
Curdled milk, yoghurt.
Cooked fruits, marmalades, preserves.
Raw fruits (peaches, grapes, oranges, tangerines, etc.).
Dry cakes, crackers, small tarts.
Water, infusions.

Typical Menu:

7 a. m. Milk soup or pap.
9 a. m. Fresh fruit (bunch of grapes, strawberries or orange).
11 a. m. Milk soup.
Mashed potatoes with milk.
Preserves.
Saltless crackers.
Water.
4 p. m. Fresh fruit (peach, grapes or orange).
5 p. m. Milk soup.
Mashed potatoes with milk.
Preserves.
Saltless crackers.
Water.
8 p. m. Milk soup or pap.
Fresh fruit.
A cup of sweetened milk in the night.

Physical Agents.

GENERAL CONSIDERATIONS ON PHYSICAL THERAPY.

Medicine is slowly but inevitably rising toward a more comprehensive conception of pathogenesis, in which each day there is entering more clearly the thought of an evolutional equilibrium between the cosmic environment and the internal organic medium.

Therapeutics, in turn, is developing along the lines of systematic application to curative ends of the various agencies or modalities afforded by this environment (air, light, heat, moisture, electricity, various radiations, etc.).

An actual renaissance of physical therapy, long in desuetude, is being witnessed. The word *renaissance* is used because, while it is true that a few procedures, such as the Röntgen rays and radium therapy, are really new, and a few others, such as electrotherapy, have been completely recast, there are some in which the ancients were past-masters. Hydrotherapy and massotherapy are among these, as evidenced in the Roman and Greek thermal establishments; treatment by exercise was in high honor in the ancient world, at least for educational and esthetic ends; climatic treatment, heliotherapy and open air treatment were also more or less systematically practiced.

Under the vigorous impulsion, first of the empirics, then of the systematic specialists, each branch of physical therapy has become an autonomous science, often with many ramifications, and really active. In the aggregate it may already be said that therapeutics by physical agencies surpasses in its results therapeutics by pharmaceutic agencies and is almost on a par with dietetics.

It is, therefore, no longer permissible for the practitioner to be unfamiliar with its essential procedures, some of which are already in current daily use. It is necessary for him to know how and be able correctly to treat fractures by massage; remedy respiratory insufficiency by appropriate rational exercises; direct the electric treatment of a muscular atrophy; formulate a course of systematic

hydrotherapy, even if it be merely in typhoid fever; expound the indications for radium treatment in the various forms of neoplasm, and plan an intelligent course of climatic treatment for a tuberculous case—to mention only a few examples.

Specialists in physical therapy are forced to steer clear of the very natural and almost insuperable tendency on their part to a narrow, and consequently erroneous and dangerous, conception of therapeutics based exclusively on the use of the physical agency in their practice. The non-specialists, on their part, accept only with mistrust and timidity these therapeutic methods of which most of them are ignorant (where could they have learned them?) and which awkward proponents have compromised by excessive and inconsiderate use.

CLIMATIC TREATMENT.

A discussion of climatic treatment may either require an entire volume—or be condensed in a relatively few pages. It is this second alternative, naturally, which will be resorted to here. The main principles of practical climatic treatment will be found given below in the text and in special tabular presentations.

GENERAL PRECEPTS OF CLIMATIC TREATMENT.—Climate, with the allied procedures—courses of feeding, rest, air, light, exercise, walks, games, sports, etc.—is being increasingly availed of as a therapeutic agent. In the aggregate, it is one of the most potent measures available for the treatment of certain chronic disorders.

Before the study of climatic therapy is taken up, however, there are a few facts of general clinical therapeutics which it will be well to recall and which apply, as a matter of fact, to all therapeutic agencies, chemical or physical.

In every course of climatic treatment it is necessary to consider: 1. The climate. 2. The patient. 3. The disease. 4. The physician.

1. **The Climate.**—A few propositions are fundamental in this connection.

(a) *There is no specific climate for any given disease,* but there are climatic conditions more or less favorable or unfavorable to recovery from certain disorders. Thus, neither altitude nor the sea constitute climatotherapeutic agencies sufficient and necessary for the cure of tuberculosis, but agencies which, properly gauged and administered, are capable of being of service in such a cure. "There are climatic factors of capital importance to the cure of tuberculosis which may be met with at the seashore, in the plains, or in the mountainous regions of low, intermediate or high altitude. But there exists no curative climate specific for tuberculosis." (Schröder.)

(b) *It is well to individualize the resorts as much as possible,* as the position of a hill or the proximity of forests is sufficient markedly to differentiate two resorts in the same region and even very close together, as in the case of Biarritz, France, harmful to tuberculous cases, and Arcachon, reputed to be favorable in the same cases.

2. **The Patient.**—Study of the patient, of his constitution, should rank above the disease factor itself in the climatotherapeutic equation. If the patient has a robust constitution, which reacts regularly and easily to variations of temperature, and is normally resistant to cold,

one may recommend, according to clinical conditions, a climate requiring strong powers of acclimation, such as the high altitude climates or the active marine climates. If, on the other hand, one is dealing with originally weak, asthenic individuals, reacting poorly to cold and whose pulse is easily disturbed, low altitudes and the temperate seashore climates should be preferred; the more strongly featured climates would exceed the purpose aimed at, the system would not adapt itself to them without disturbance, and there would be a more marked upset of the normal equilibrium, which would favor the disease.

In a general way, abrupt, rapid and violent climatic variations should be avoided for erethistic, nervous and congestive individuals with exaggerated reactions, as well as for febrile patients; on the other hand, the lymphatic, sluggish, afebrile, and atonic subjects will often profit from "stimulation" by climates necessitating rather rapid adaptations, provided, however, as mentioned above, that such adaptations be feasible for the system of the person under consideration.

3. **The Disease.**—Just as it is advisable to individualize the resorts, so it is advisable very carefully to individualize the patients and in this connection to take into account the two main morbid factors, *viz.*, the constitution of the patient, just referred to, and the form of the disease present. Thus, considering only tuberculosis, a given climate may be favorable or dangerous according as the patient is febrile or afebrile, is or is not subject to hemoptysis, has laryngeal involvement or is free of it, etc.

4. **The Physician.**—One may say of climatic treatment what may be said of any therapeutic method, *viz.*, that it is of value only according to the physician who is directing it; and of climate, what may be said of drugs, *viz.*, in every climate there are several climates. This is what Sardon, of Nice, said in his judicious expressions on "Climatic Dosage:" "Many individuals do not support an overdose of climatic stimulation any more easily than they do an overdose of digitalis or of aconite. In both instances, one must take the trouble to study the drug and the patient in order to have the activity of the one appropriate to the susceptibility of the other. It is only at this price that clinical climatology may offer the desirable degrees of safety and efficacy.

"On the other hand, why deprive a patient of the useful influence of climate in rational dosage because others have suffered from an incautious dose? Examples are many of disappointments attributable solely to disregard of the law of dosage and which are too often interpreted in the direction of a condemnation *en bloc* of the climate. Establishment of proper dosage is the necessary foundation for an equitable appreciation of the resources of any climate, and particularly of an active climate."

Nothing would be more dangerous for a patient than to follow out a climatic cure—at least a rigid one—without submitting, at least at the start, to the close supervision of a careful physician thoroughly familiar with the features of the resort.

In conclusion, let mention be made of the psychotherapeutic action consciously or unconsciously exerted by a thoroughly posted, attentive physician possessing that quality of prime importance in therapeutics, *viz.*, the *personal authority* which generates beneficial suggestion, and we shall understand why the same patient, under like climatic conditions and subjected to practically the same treatment, will recover under one man and make no progress with another. Therapeutics, like the heart, has its reasons which reason does not always know of, or at least not accurately.

An attempt has been made to condense the more *indispensable facts of practical climatotherapy* in the accompanying tables.

CLIMATOTHERAPY.

MARINE CLIMATES.	CONTINENTAL CLIMATES.		
Tonic. — *Stimulant.*	HIGH ALTITUDE (above 1200 meters—4000 feet).	INTERMEDIATE ALTITUDE (500 to 1000 meters—1600 to 3200 feet.)	LOW ALTITUDE (below 500 meters —1600 feet.)
Climatic Features.			
1. Relatively small temperature variations.—*Relative* stabilization of the temperature (as compared to interior climates). 2. Absence of dust and germs. 3. Relatively high humidity and salt content in the air. 4. Intensity and long duration of sunlight (in some regions). 5. Frequent, high winds.	1. Rarefied atmosphere and low barometric pressure. 2. Pure air, absence of dust and microörganisms. 3. Longer duration of sun exposure. 4. Low humidity. 5. Very low temperature. 6. Large variations in temperature. Large variations from day to night. Large variations from sunlight to shade.	More damp, less sunny, warmer, and with higher barometric pressure than the high altitudes, the climate at intermediate elevations proves less stimulating, less tonic, but also less excitant; it requires less powers of adaptation, so that while as powerful a stimulation is not to be expected from it, it is much better borne, and is suitable in a larger proportion of patients.	An indifferent climate without any marked specific feature. The climate of each resort is profoundly influenced by the vicinity of mountains or of the sea, the presence or absence of extensive wooded districts, the presence or absence of an adjacent large lake or river, the nature of the soil (clayey or sandy, pervious or impervious), the density of agglomeration, the proximity of a large city or of factories, etc.
Physiologic Action.			
1. Stimulating action on blood formation. 2. Stimulation of digestion and nutrition. 3. Nervous stimulation, to be kept under watch in some subjects. 4. Elevation of blood-pressure. 5. General organic stimulation. 6. Antiseptic action (sunlight, ozone, iodine?).	1. Stimulation of respiratory function. 2. Stimulation of the circulation. 3. Stimulation of skin functions. 4. Stimulation of digestion and nutrition. 5. Increased number of red blood-cells. 6. 1st stage: Nervous excitation. 2d stage: Adaptation and euphoria.		

Indications.			
1. **Local** tuberculous processes, especially of bones or lymphatics (with the assistance of heliotherapy). 2. Tuberculous subjects over 35 years of age. 3. Tuberculosis in children. 4. Sluggish, afebrile tuberculosis without lung congestion. 5. Mild cardiac disturbances. 6. Nervous subjects of the depressed type. 7. Chlorotic anemias.	1. Pulmonary tuberculosis, except erethistic or galloping cases. 2. Anemias. 3. Debilitated subjects predisposed to tuberculosis or anemia; convalescents. 4. Hay fever. 5. Many forms of neurasthenia. 6. Rest with distraction and sports for the overworked.	They may be suitable, temporarily at least, in: 1. Tuberculous cases, even with fever or a tendency to lung congestion. 2. Pulmonary emphysema. 3. Various types of nephritis. 4. Tendency to cardiac dilatation. 5. Aged persons. 6. Nervous erethism with anorexia and insomnia. 7. Neuro-arthritic cases.	The towns at little or no elevation do not lend themselves to group study. They "share more or less the characteristics of the mountain climate or the seashore climate according to their geographic position and exposure, and according to the mountains, streams and forests in their vicinity. It is particularly in respect of them that studies of local climates are warranted." (F. Lalesque.) No general indications or contraindications to these places can be formulated. The resorts should be considered individually.
Contraindications.			
1. Pulmonary tuberculosis when acute, febrile, congestive, erethistic, or accompanied by hemoptysis. 2. Poorly compensated heart conditions. 3. Aortitis, aneurism, angina pectoris. 4. Nervous, excited subjects. 5. Eye disorders (blepharitis, conjunctivitis). 6. Ear affections (otitis, otorrhea). 7. Weeping or itching skin conditions.	1. Acute febrile diseases. 2. Grave cardiac or vascular diseases (aortitis, angina pectoris, cardiac insufficiency). 3. Pulmonary emphysema. 4. Nephritis. 5. Nervous overexcitability: epilepsy. 6. Laryngeal tuberculosis. 7. Extreme weakness. 8. Senility.	Aside from serious cardiac or vascular disease, there are no general absolute contraindications to cures at intermediate elevations; it all depends on the character of the resort and the patient's condition.	

CLIMATIC RESORTS.*

GENERAL CLASSIFICATION OF CLIMATIC RESORTS.

(Modified from H. WEBER.)

A. Marine Climates.

I. Marine Climates with High Humidity.

1. *Warm and Moist Marine Climates:*
   Florida, Georgia, South Carolina, Bermuda, Cuba, Jamaica. Barbadoes, Bahamas, Hawaiian Islands, Madeira, Azores, Canary Islands, various South Sea Islands, Ceylon, St. Helena.
2. *Cool and Moist Marine Climates:*
   Orkney and Shetland Islands, Hebrides, Bergen, Iceland, Auckland Islands, Falkland Islands.

II. Marine Climates with Medium Humidity.

1. *Warm Marine Climates of Medium Humidity:*
   Old Point Comfort, Virginia Beach, San Diego, Coronado Beach (Cal.), Eastern Riviera, Venice, Palermo, Ajaccio (Corsica), Biarritz (France), Algiers, Tangiers, Gibraltar, Lisbon, Cadiz, Vigo, Santander, Balkan Peninsula, Corfu, Crimea, New Zealand.
2. *Cool Marine Climates of Medium Humidity:*
   Newport (R. I.), Isle of Shoals, Nantucket, Mt. Desert Island, Fire Island, English and Irish Coasts.
   (*a*) Winter resorts: Florida, Lakewood (N. J.), Santa Barbara (Cal.), Queenstown, Isle of Wight.
   (*b*) Summer resorts: Various Southern California resorts, North Coast of Cornwall and Devonshire, Wales, Ireland, North Coast of France, Brittany, Belgium, Holland, Norway.

*[In the French edition a rather detailed account of the climatic resorts in France is alone given. In view of the restricted utility of this information to American readers, it has been thought advisable to substitute a more general presentation, the first portion consisting of a classification of the climatic resorts in various parts of the world, and the second, a brief review of the better known resorts in the United States. Finally, a greatly condensed description of the French resorts is given.—TRANSLATOR.]

III. Marine Climates with Low Humidity.

New Jersey coast resorts, Western Riviera (Nice, Monte Carlo, Mentone, etc.), Naples, Capri, Ischia, Malta, Balearic Islands, Athens, Smyrna, South Africa, Australia.

B. Inland Climates.

I. Altitude or Mountain Climates.

Adirondacks, Catskills, Alleghenies, Pocono Mountains, White Mountains, Green Mountains, Asheville, Rocky Mountains, Colorado Springs, Denver, Pasadena (Cal.), Mexico, Davos and St. Moritz (Switzerland), Alpine resorts in general, Apennines and Maritime Alps, Peruvian Andes, South Africa, India.

II. Climates of Low Levels.

Dry and Warm Climates: New Mexico, California, Africa.

Dry and Cold Climates: Minnesota, Canada.

Moderately Moist Climates: New England States, Saratoga (N. Y.), Los Angeles, Pau (France), Rome, Pisa (Italy).

SOME CLIMATIC RESORTS IN THE UNITED STATES.*

ADIRONDACKS.—An elevated plateau from 1500 to 1900 feet high, lying in the northeastern portion of New York State, west of Lake Champlain. Country thickly wooded, partly with pines of many varieties. Chief resort: Saranac Lake (1539 ft.), in or near which are the Trudeau "Adirondack Cottage Sanatorium" and many other smaller institutions.

Climate.—Cool, cloudy weather a marked feature. Winters cold and summers cool. In an analysis covering 10 years, Lawrason Brown found the mean temperature to be 14.98° F. in January and 66.24° in July. A temperature of 90° was recorded 19 times in the 10 years. Precipitation occurred on 145 days each year, the annual average being 34.55 inches. The average annual snowfall was 90.74 inches, constituting 26 per cent. of the total precipitation, and extending from September to May. Rainfall is rapidly absorbed owing to the porous nature of the soil. Fogs and mists are rare except in the early morning hours. The average annual number of clear days was 121.9, and of cloudy days, 128.9. The climate may be summarized as cool and moist during 7 months

*[In part condensed from W. R. HUGGARD, *"Handbook of Climatology."*—TR.]

and cold and dry during 5 months of the year. There is freedom from dust and disagreeable winds.

Indications.—Tuberculosis, hay fever.

ASHEVILLE.—A winter resort for consumptives situated on a plateau in western North Carolina, at an altitude of 2250 feet. There are no mountains in the immediate vicinity of the town, but the neighboring mountain peaks attain a height of 6000 feet. Forest trees extend from near the town to the summits of these mountains.

Climate.—Winters not so cold as in the Adirondacks, but summers warmer. In observations covering a number of years, by J. W. Gleitsmann, the mean temperature in January was 37.7° F., and in July, 72.6°. Average annual rainfall, 42.55 inches. Fair and clear days per year (two years only) numbered 259. Mean relative humidity, from 59.51 in March to 80.13 in August. Soil dries quickly after rain. The surroundings afford a considerable amount of shelter from winds.

Indications.—Best for tuberculous cases with strength enough to take a fair amount of open air exercise, with the disease not in a very advanced or active condition; malaria (Huggard).

Other Resorts in Same General Region.—Aiken, S. C., (565 ft.); Thomasville, Ga.

FLORIDA.—Florida has enjoyed high repute as a winter resort for consumptives. Country extremely flat, with soil for the most part sandy, and tropical vegetation. Visited mainly in January, February and March to escape the cold and winds of the more northern States.

Climate.—Jacksonville and St. Augustine, on the Atlantic coast, and Tampa and St. Petersburg, on the Gulf coast, are the points of chief importance. The resorts on the Gulf side are distinguished from the others by a higher temperature, greater equability of temperature, a somewhat moister air, and comparative absence of sea breezes.

Mild temperature, considerable sunshine and an intermediate degree of moisture are the chief characteristics of the winter season. H. Richards gives the December mean temperature as 55.8° F.; January, 58.8; February, 58.1; March, 62.7; April, 69, and July, 82.5. Mean relative humidity, from 65.4 in March to 77.4 in September. Average annual rainfall, 54.68 inches, much

of which occurs from June to October. Fair and clear days per year, 279.9. Sea winds and sand dust may be a little troublesome on the Atlantic coast.

Indications.—For winter residence in cases of lung disorders which would not stand the northern temperatures. Permits of spending a great amount of time in the open air without exposure to low temperatures. Frequently suitable for persons who have not stamina enough to react to the stimulus of a cold climate, their organs being unable to respond to the extra demand entailed by the latter.

COLORADO.—This State occupies an extensive plateau with an elevation of, roughly, from 4000 to 6000 feet. The Rocky Mountains run north and south a short distance west of the main health resorts—Denver and Colorado Springs—and largely shut out the moist winds from the west, thus affording these resorts an unusually low degree of humidity.

Denver is at an elevation of 5196 feet and stands in an open plain, 30 miles east of the main mountain ridge. There is a conspicuous absence of trees, save such as are planted and irrigated. Colorado Springs is some 70 miles south of Denver, and lies 10 miles east of the summit of Pike's Peak. It is thus much nearer to hills than Denver.

Aside from these two main resorts, there are many smaller ones, including Glenwood Springs, which has some reputation as a summer resort for rheumatic invalids, and Estes Park and Palmer Lake, both over 7000 feet above sea-level, which are especially availed of in the summer.

Climate.—The main climatic features of these resorts are, a large amount of sunshine, very little rain, a hot summer and a cold winter. Statistics show a mean temperature of 27.2° F. in January and of 72.0° in July. The temperature occasionally rises to 95 or 100° in summer and may descend to —10 or even —25° in the winter. The mean relative humidity for the year is but 48 per cent. and the yearly rainfall but 14.95 inches. About two-thirds of the precipitation occurs from April to August, so that snow seldom falls in winter. The amount of wind is the most serious drawback, the frequent stiff winds blowing clouds of fine dust in the air and compelling invalids to stay indoors. There is some liability, especially among new-comers, to bronchial catarrh; and dryness of the nose and throat due to the dry

atmosphere may be complained of. High solar radiation and abrupt changes of temperature are features of the climate.

In Colorado Springs the climate is similar to that of Denver except that it is more windy, there being not a few days in which dust storms prove objectionable although the sun may be shining and the temperature pleasant. Statistics of H. Richards show fair and clear days amounting to 316 days in the year. Ely summarizes the condition as: "A remarkably dry atmosphere, a rainless winter, a large amount of clear weather, a very warm sunshine, and the purest of air." The winter climate may be less seductive than that of more southern latitudes, but the resort is adapted for living all the year round.

Indications.—The Colorado resorts are best suited for patients with a considerable reserve of vitality. The time spent out of doors depends somewhat upon the patient's ability to take active exercise and resist cold. Patients at a low ebb, with poor circulation and feeble assimilation, do better in the lowlands and in a warmer, less dry climate. For consumptives whose disease is arrested, with a fairly robust constitution, and whose calling in life can be exercised only in a large town, it may be possible to live in Colorado in comparative health and at the same time earn a livelihood. Asthmatics do well in Denver (Huggard).

SOUTHERN CALIFORNIA.—The portion of California lying south of San Francisco, especially the coastal section of it, enjoys a climate in many respects unique, due to the southern position of the country, the Pacific Ocean on one side and a mountain range succeeded by a high plateau on the other. The neighboring inland deserts, when overheated by the sun, draw in cold air from over the ocean as the heated air ascends from their surfaces, thereby maintaining a pleasant coolness of the shore districts in summer. The hotter the sun's rays inland, the more actively this cooling effect on the coast is exerted.

Among the chief climatic resorts are San Diego, situated at the extreme southwest corner of the State, on the northeast shore of the bay of its own name; Santa Barbara, pleasantly situated about 1 mile from the shore, some 50 miles below Point Conception (where the coast takes an easterly bend), in the foothills of the Santa Ynez Mountains; Monterey, on the coast about 80 miles south of San Francisco; Los Angeles, about 14 miles from the coast and at an elevation of 283 feet above sea-level, and

Pasadena, 7 miles northeast of Los Angeles and at an elevation of about 1000 feet.

Climate.—The climate throughout the district is characterized by mild winters, cool summers, and abundance of sunshine. In San Francisco the mean winter temperature is 51.2° F. and the mean summer temperature, 58.4°. Its utility as a possible health resort is impaired, however, by the violence of the wind during the summer months.

San Diego, situated farthest south, enjoys the mildest climate and most equable temperature of any of the California resorts. Its mean winter temperature is 54° F. and it is comparatively free from wind. The annual rainfall is but 9.49 inches, according to the statistics of H. Richards, and nearly all of this precipitation occurs in the months from November to March. The mean temperature of the warmest month, August, is 68.7°. The average yearly number of fair and clear days is 277.8. It is slightly inferior to the other resorts in having a higher degree of humidity (75.5 per cent. in March) and in winter is usually visited by a morning fog.

Santa Barbara enjoys a climate differing from that of San Diego only in a slightly lower and somewhat greater range of temperature and a somewhat less degree of humidity. Observations by H. D. Vail over 25 years, quoted by W. H. Flint, show a mean temperature of 53.5° F. for January and of 66.7° for August; a relative humidity ranging from 65 per cent. for December to 76 per cent. for July, and an average annual rainfall of 17.0 inches, practically all of such precipitation occurring from November to April. The average annual number of absolutely clear days has been estimated by Gidney, from 15 years' observations, at 241; of fair days at 56; of cloudy days at 68, and of rainy days at 32, the cloudy and rainy days occurring almost exclusively in the winter and spring. Fogs, chiefly at night, occur frequently from May until October, but being high, do not deposit much moisture. There are a few days in the spring months when disagreeably strong northwest or north winds prevail, but the average wind velocity is low. A feature of the climate is a cool land breeze, produced by the descent of air from the cool mountain tops soon after sunset, producing a sudden fall of temperature at this time. After midnight, however, this cool breeze is likely to have ceased and a rise of several degrees to have occurred from the temperature existing after sundown (Flint).

This feature makes conditions very favorable for out-of-door sleeping, which can be enjoyed in comfort nearly all the year round. Purity of the air is insured by the constant alternation of ocean and mountain currents, both coming from unpolluted regions.

Monterey has a climate somewhat cooler than either San Diego or Santa Barbara, but in other respects similar.

Los Angeles exhibits a climate slightly more of the inland type, with somewhat greater heat in summer and greater cold in winter, but a lower humidity and less frequent fogs than the coast resorts. It is also relatively free from strong winds. Statistics of H. Richards show a mean temperature of 52.2° F. in January and 69.2° in August, a relative humidity of from 57.3 per cent. in November to 71.9 per cent. in March, a yearly rainfall of 14.52 inches, and 316.1 fair and clear days per year.

Pasadena, at a higher elevation than Los Angeles, closely resembles the latter in its climatic features, but is practically free from fog and has a lower relative humidity.

Indications.—Southern California is suitable for a large variety of invalids by reason of the mildness of its climate, the moderate degree of humidity, and the absence of extremes of heat and cold. If the humidity in the winter at some points appears a drawback, it can be avoided by adopting one of the more inland stations, such as Pasadena, while excessive dryness in the summer is avoided at the coast resorts. Such dryness, induced by hot winds, has, indeed, been pointed out as the cause of a depressing influence on the nervous system as well as of irritation of the respiratory mucous membranes, alkaline dust being sometimes carried into the air. In general, however, even delicate invalids withstand the Southern California climate, which permits nearly every one to spend the greater part of the day in the open air throughout the year.

Such a climate is deemed suitable for many cases of pulmonary tuberculosis, though more especially for those who, while having little or no active disease, are predisposed to it, or those in whom the disease has been arrested. According to W. H. Flint, cases of advanced tuberculosis, chronic rheumatism and asthma generally do badly at Santa Barbara, the tuberculous cases requiring even greater dryness of air than is to be found in this locality. Asthmatics may be cured, however, by residence in the foothills, and a favorable influence is exerted by Santa Barbara and

its foothill region on neurasthenia, cardiac and renal diseases, and chronic bronchitis, as well as arrested tuberculosis. Chronic rheumatic cases do best in the resorts with the greatest warmth. The climate of Southern California is, furthermore, very suitable for old people, persons of feeble vitality or broken down by overwork, convalescents from acute diseases, and young children. Hay fever patients are also stated to obtain much relief.

CLIMATIC RESORTS IN FRANCE.

I.—MEDITERRANEAN CLIMATE.

AJACCIO.—Situated in Corsica, on the sea. Full southern exposure.

Climate.—Tonic and mildly sedative. Mean winter temperature: 13° C. (55.4° F.); uniform winter temperature. Surrounded by mountains and protected from wind.

Indications.—Tuberculosis, even with fever and congestive tendencies.

ALGIERS.—A seaport in Algeria.

Climate.—The winter temperature ranges from 9.5 to 20.3° C. (48.6 to 68.6° F.); it is not only mild, but relatively equable. The value of the lower portion of the resort lies in the sea air; of its upper portion, in the altitude. In both instances, a mild stimulating action results, but in different respects.

Indications.—Tuberculosis (cases with congestion or hemoptysis should, however, not remain after April). Also: Convalescence, anemia, debility, rheumatism and albuminuria.

CANNES.—Situated on the southern coast of France, in the Western Riviera.

Climate.—Mean winter temperature: 10.4° C. (50.7° F.). Protected against all but southerly winds by a semicircle of wooded hills. Strong solar radiation. The daily outdoor period for patients extends from 1½ hours after sunrise to 20 minutes before sunset. Season: October to June. Numerous therapeutic establishments. Climatic effects: Tonic, reconstituent, resolvent and stimulant.

Indications.—Lower, sea section: Patients requiring a brisk reaction. Upper, inland section: Patients with congestive disturbances, nervous and febrile patients.

Debility, convalescence, diabetes, gout, obesity, chronic rheumatism, anemia and chlorosis, neurasthenia with but slight irrit-

ability, bronchitis and emphysema, asthma, nephritis, arteriosclerosis, rickets, localized tuberculous processes, tracheobronchial adenopathy, and pulmonary tuberculosis.

Contraindications.—Acute phthisis, cerebral and spinal disorders in their subacute stages, febrile and congestive disorders in general.

MENTON.—In the Western Riviera.

Climate.—Mean winter temperature: 12 to 14° C. (53.6 to 57.2° F.)—higher than at the other Mediterranean resorts; this is also the driest of the resorts. Attenuated sea climate; no fog. Outdoor day for patients from 8 or 10 a. m. to 4 or 5 p. m. Absolutely protected against cold winds. Tonic-sedative climate. Air and sea cures, plus heliotherapy. Season: Winter and spring.

Indications.—Incipient tuberculous cases, usually afebrile and with little nervousness. Weak, neurasthenic or arthritic subjects.

NICE.—In the Western Riviera.

Climate.—Mean winter temperature: 9° C. (48.2° F.). Dry winters. Sunny and dry climate, stimulating metabolism and functional activities. Prolonged outdoor exposure, heliotherapy, and exercise. The resort includes a variety of localities permitting of graded selection between the "strong dose" of the seacoast and the "weaker dose" of the lower Alpine slopes. Season: Winter and spring.

Indications.—Debility, depression, overwork, convalescence, arthritism, heart disease with compensation, albuminuria, etc.

Contraindications.—Tendency to excessive functioning, to nervousness, to fever, to congestive states or to hemoptysis.

Other Resorts in the Same Region: Beaulieu-sur-Mer, Grasse, Hyères, Saint-Raphael, Thorenc.

II.—ATLANTIC CLIMATE.

ARCACHON.—Situated on an inlet of the sea, southwest of Bordeaux, partly in the coastal pine forest.

Climate.—Mean winter temperature, 6.6° C. (44° F.). Prevailing winds: North and northwest (sea winds). Attenuated sea climate, tonic from its sea quality and sedative from the adjoining forests. Clear, pure atmosphere, rich in ozone. The forest regulates the temperature and humidity, purifies the air, and exerts a curative action by virtue of the turpentine vapors set free through oxidation of resins. Air and sea cure, heliotherapy,

electrotherapy and sea bathing. Season: Summer and winter (October to end of May). The winter town is on the side of the inlet opposite the sea, protected by a hill; it contains many small home-sanatoriums.

Indications.—Tuberculosis, especially pulmonary of the erethistic type, and peritoneal; tracheobronchial adenopathy, asthma, neurasthenia, heart disorders.

BIARRITZ.—Situated lower on the Gascony coast than Arcachon, near the Pyrenees.

Climate.—Being on a promontory, it is exposed to the sea air currents, warmed by the Gulf Stream. The surrounding belt of mountains, arresting these air currents, form a reservoir of warm air at this point of the coast. Mean winter temperature: 9.1° C. (48.4° F.). Prevailing winter winds: South and southwest. These winds are frequent and strong. Climatic effects: Tonic, stimulant, resolvent and even sometimes excitant. Season: Entire year, though the autumn is most favorable.

Indications.—Debility, overwork, convalescence, scrofula, adenitis, bone tuberculosis.

Contraindications.—Pulmonary tuberculosis; congestive and febrile tendencies.

III.—CHANNEL CLIMATE.

BERCK.—Situated high up on the Channel coast, below Boulogne.

Climate.—Bathing resort much exposed to winds, especially westerly. Sea climate applied to the maximum extent. Numerous hospitals, orthopedic institutes and sanatoriums. Air cure, sea baths and sand baths. Season: Entire year.

Indications.—Surgical tuberculosis, especially of bones, joints and lymphatics.

Contraindications.—Pulmonary tuberculosis, neuroses, fever, hemoptysis.

IV.—INLAND CLIMATES.

GERARDMER.—In the Vosges Mountains in eastern France, at an elevation of 671 meters (2201 feet), on the shore of a lake.

Climate.—Maximum summer temperature: 25° C. (77° F.). Cool evenings and nights. Sedative climate; silver fir forest. Hydrotherapeutic establishment. Season: Summer.

Indications.—Nervous diseases, anemia, neurasthenia, debility.

PAU.—A town in southwestern France, near the Pyrenees. Elevation, 207 meters (679 feet).

Climate.—Mean winter temperature: 8 to 10° C. (46.4 to 50° F.). Sheltered from the wind. Very dry climate; frequent rains, but the ground dries out quickly. Equable temperature. Sedative to nervous system and circulation, facilitating respiration. Outdoor treatment, including outdoor sleeping. Various physiotherapeutic establishments in the vicinity. Season: October to June.

Indications.—Nervous, irritable subjects in general; tuberculosis (especially forms with erethism or fever); also neuroses, overwork, neurasthenia, neuralgia, angina pectoris.

Contraindications.—Depressed states.

V.—MOUNTAIN CLIMATES.

I.—Alps.

CHAMONIX.—In Savoy, at the foot of Mont Blanc. Elevation, 1050 meters (3445 feet).

Climate.—Tonic, with rather cool nights. Air pure and exceedingly dry. The abundance of firs and larches affords a favorable atmosphere for respiratory disorders. Mean summer temperature: 18° C. (64.4° F.). Very little air motion. Summer season: May to October; the winter season is sometimes unusually protracted, depending somewhat on the amount of snow.

Indications.—Debility, convalescence from serious illnesses, anemia and chlorosis, physical and mental overwork, neurasthenia (especially in depressed forms), tuberculosis.

Other Resorts in the Same Region (French Alps): Abries, Abondance, Aiguilles, Argentières, Beaufort, Le Chatelard, Les Contamines, Les Cluses, La Chartreuse du Reposoir, Flumet, La Grave, Le Lautaret, Mégève, Le Monnetier, Pralognan, Praz-de-Lys, Le Revard, Saint-Gervais-les-Bains, Samoens, Lesvoirons (altitudes from 495 to 2070 meters—1624 to 6791 feet).

II.—Pyrenees.

Les Escaldes, Font-Romeu, Luchon-Climatique, La Preste (altitudes from 1200 to 1800 meters—3937 to 5905 feet).

III.—Mountains of Central France.

LE MONT-DORE.—Near Clermont-Ferrand. Elevation, 1050 meters (3445 feet).

Climate.—Suitable for open air treatment at a high altitude. A cog railway is available to take persons up to 1300 meters (4265 feet) when desired. A thermal establishment is also located here. Season: June to October.

LE MONT-PILAT.—Situated on a broad, undulating plateau, overlooking the Rhône valley.

Climate.—Very cool and pleasant. Fogs uncommon in the summer but very frequent in winter. Extensive fir forests. Mean summer temperature: 16 to 18° C. (60.8 to 64.4° F.). Season: Summer.

IV.—Vosges Mountains.

Gérardmer (see under IV. INLAND CLIMATES).

La Schlucht, elevation, 1150 meters (3773 feet).

HYDROTHERAPY.

The term hydrotherapy is commonly used to designate collectively the therapeutic procedures having to do with the external application of water over the whole or part of the body. The variety (bath, douche, tub, ablution, pack, etc.), the temperature (cold, hot or indifferent), the pressure (*nil*, strong, percussion, intermediate, etc.) and the duration (long, medium or short) of such procedures afford an indefinite number of possible combinations.

The object always sought, whatever be the modality, temperature, duration or pressure, is to obtain on the part of the body a reaction in some definite direction and in answer to some definite indication.

THE HYDROTHERAPEUTIC REACTION.—Observation of this hydrotherapeutic reaction governs the application of the measure. It constitutes an actual therapeutic test which permits of rational adaptation of hydrotherapeutic practices to the clinical condition and patient under consideration.

This reaction is manifested in several kinds of effects:

On the nervous system, there is produced, according to the hydrotherapeutic modality used and the reactive power of the patient:

Either a *tonic, stimulant action,* used in cases of depression, of sluggish function and of low blood-pressure, and which will often be secured by a brief (few seconds) hydrotherapeutic application, or a very hot (40 to 45° C.—104 to 113° F.) or a very cold (8 to 16° C.—46.4 to 60.8° F.) application, or an application with pressure (needle douche) or without pressure (pack, wet sheet, sponge bath).

Or, a *sedative, soothing action,* used in cases of excitement, nervousness, erethism, and high blood-pressure, and which will often be secured by tepid hydrotherapeutic modalities (28 to 33° C.—82.4 to 91.4° F.) applied for 20 minutes to one hour or longer, or to tepid procedures with a low degree of pressure (sponge baths, ablutions, packs).

On the circulatory system, one observes, chiefly with hydrotherapy, the following effects:

In a *first stage,* which is very brief, peripheral vaso-constriction, with pallor and cooling of the skin, upon the initial contact of the cold water.

In a *second stage,* more prolonged, a vaso-dilatation with pink or red coloration of the skin and a sensation of warmth.

This reaction is of a specific character. It must always be obtained. If the reaction does not occur or is incomplete or atypical; if the patient fails to react or reacts poorly, remaining pale and shivering, the hydrotherapeutic procedure employed is inappropriate, and will have to be modified both as to modality, duration and temperature.

The **thermic reaction** is sought only in hyperthermia, and will be found described in the section on that subject.

ORDINARY INDICATIONS FOR HYDROTHERAPY.—There are few disorders in which hydrotherapy in some form or another is not capable of rendering great service, and it would be tiresome to review all the indications and modalities, as this would really involve a review of the whole of clinical medicine. Let it be recalled merely that the main indications for hydrotherapy are the following:

1. **Infectious Diseases.**—Hydrotherapy successfully antagonizes two of the most salient symptoms of infections, *viz., fever* and *adynamia.* The details of the use of its several modalities in these cases will be found described in the sections on *Fever* and on the *Infectious Diseases.*

2. **Nervous Diseases.**—In these, four effects are sought:

(*a*) *Sedative effect,* obtained by the tepid or indifferent procedures (prolonged lukewarm baths at 33 to 35° C.—91.4 to 95° F.; showers, wet packs, sponge baths, etc.), and which is sought in periods of excitement, delirium, insomnia, restlessness and nervous erethism.

(*b*) *Tonic, stimulant effect,* obtained with the short procedures (a few seconds to one minute), or the very hot (above 40° C.—104° F.) or very cold (below 20° C.—68° F.) procedures, with or without pressure (douches, sponge baths, immersions, ablutions, packs), and sought in periods of asthenia, lassitude, aboulia or torpor. Let it be noted once again that the vasodilator, heat-giving, euphoric secondary reaction is the evidence of adaptability of the hydrotherapeutic procedure to the case under treatment. To grasp thoroughly the action, reactions and modalities, the observer must have practised hydrotherapy systematically himself.

(*c*) *Training, hardening, habituating effect,* obtained wtih progressive modalities of excitant hydrotherapy, beginning with the mildest and most sedative (hot or tepid ablutions) and reaching gradually the most stimulating brief, cold and pressure-bearing modalities (cold pressure douches, Scotch douches). Such a systematic "training" is intended to antagonize the morbidly excessive reactivity of some subjects and the low reactivity of some others through a progressive adaptation of the body to forms of excitation of graded intensity. It

TREATMENT BY MEDICATED BATHS.

KIND OF BATH.	DRUGS TO BE ADDED IN BATH FOR AN ADULT.	INDICATIONS.
Alkaline Baths.	Sodium carbonate: 250 to 300 grams (8 to 10 ounces). Aromatic alkaline baths (Pennès baths) may be ordered by prescribing powders each containing 300 grams of sodium carbonate together with small amounts, 1 to 8 grams (15 to 120 grains), of sulphates, of phosphates, and of potassium bromide, made aromatic with the volatile oils of lavender, thyme and rosemary and with tincture of staphysagria.	*These are mainly indicated in all cases in which it is necessary to cleanse the superficial layers of the skin.*
Sulphur Baths.	50 to 100 grams (1½ to 3 ounces) of potassium or sodium trisulphide. The Barèges baths are a variety of sulphur baths. Each bath powder contains: Sodium monosulphide crystals, Sodium chloride, of each 60 grams (2 ounces). Sodium carbonate, 30 grams (1 ounce). Sulphur baths should be taken in bath-tubs of wood or of enamelled ware that will not be harmed by the sulphides.	*Ichthyosis, pityriasis, psoriasis.* *Acne.* *Syphilis.* *Chronic rheumatism.* *Chronic intoxication by metals (mercury or lead poisoning).*
Salt Baths.	3 to 10 kilograms (6½ to 22 pounds) of coarse sea salt in each bath. Brine baths and brine salts in powders, obtained by evaporation of sea water, may be used. They contain, in addition to the chlorides of sodium, magnesium, and potassium, bromides, iodides and sulphates. Average amount per bath: 500 grams (1 pound).	*Tonic, stimulating action; serviceable in lymphatism, chlorotic anemia, pre-tuberculosis, general debility, hyposphyxia and constitutional asthenia.* *Some forms of rheumatism (deforming type) and even of gout may possibly be benefitted.*
Carbon Dioxide Baths.	Carbon dioxide is set free in the bath. Various ready-made preparations for the purpose are on the market. Aside from these, the simplest procedure, though also that entailing the most risk in the manipulations, consists in first adding to the bath 300 to 500 grams (10 to 16 ounces) of sodium carbonate and then gradually neutralizing with hydrochloric acid.	*Neurasthenia, low blood-pressure, nervous and circulatory weakness, hyposphyxia.* *Various forms of cardiovascular insufficiency, heart disorders without loss of compensation.* *These baths should be administered with much caution in arteriosclerosis with high blood-pressure.*

TREATMENT BY MEDICATED BATHS (*continued*).

KIND OF BATH.	DRUGS TO BE ADDED IN BATH FOR AN ADULT.	INDICATIONS.
Carbon Dioxide Baths (*continued*).	Another, less caustic procedure consists in adding sodium bicarbonate to the bath, getting into the bath and then placing in it beneath one's body a tablet of sodium bisulphate. Bubbles of carbon dioxide will be set free from the tablet.	
Starch Baths.	200 to 500 grams (6 to 16 ounces) of starch, previously mixed in 2 liters (quarts) of water.	*Skin conditions with itching, hyperesthesia and a tendency to erosion and exudation.*
Gelatin Baths.	500 grams (16 ounces) of gelatin, to be dissolved in 10 liters (quarts) of water and poured into the bath.	*Itching and prurigo.*
Mustard Baths.	100 to 1000 grams (3 to 30 ounces) of mustard flour, to be first placed in a fabric bag and moistened with cold water, then introduced in the bath water.	*Capillary bronchitis or bronchopneumonia in children.* *Muscular rheumatism.*

constitutes actually a method of hardening of the nervous system which may be strongly recommended in most of the congenital neuropathies.

(*d*) *Antiphlogistic effect,* obtained by either very hot or very cold local applications in inflammatory conditions. The local application of an ice-bag is a recognized measure in such cases: Meningitis, cerebral hyperemia, etc.

3. **Circulatory Diseases.**—The effects sought are in all respects similar to those previously described:

(*a*) *Sedative effects,* sought in conditions of neuro-cardiovascular erethism, pseudo-angina, anxiety neuroses, paroxysmal tachycardia, etc., and similarly obtained with the tepid or indifferent modalities and hot (precordial compresses) or cold (ice-bag over precordium) local applications.

(*b*) *Tonic, stimulant effects,* obtained with the modalities of brief duration, either very hot or very cold. Personally, I give preference to rhythmic cold immersions of the forearms (10 to 12 times a minute in cold water, 6 to 12° C.—42.8 to 53.6° F.) or to cold ablutions of the cervical and upper dorsal regions. This is a procedure of great value in debilitated and asthenic heart cases and many instances of cardiac insufficiency.

(*c*) *Training, hardening effects* in weak and hyposphyxic subjects, obtained by means of the modalities already referred to in combination with stimulating rubs and with myotherapy and breathing exercises.

(*d*) *Antiphlogistic effects,* obtained by *precordial frigotherapy* (cold applications), which is very serviceable in many cases of *acute pericarditis and endocarditis.*

4. **Respiratory Diseases.**—(*a*) Generally, in this connection, an *antithermic, decongestive* and *antiphlogistic* action is sought through *baths* and *wet packs* (see *Diseases of the Respiratory Tract* and *Fever*).

(*b*) But it should not be forgotten that hydrotherapy is one of the best auxiliaries known of respiratory exercises. Two modalities are particularly to be recommended with this end in view:

(1) *Cold affusion to the cervical and upper dorsal region* (stimulation of the medullary centers).

(2) *Gradually and progressively prolonged immersion of the face in cold water,* which acts in three ways:

a. By reflex stimulation of the medulla by way of the trifacial.

b. By the respiratory nervous discipline it demands.

c. By the "air hunger" and deep respiration it entails.

5. **Metabolic Diseases.**—The various hydrotherapeutic modalities, combined with the standard practices of kinesitherapy (massage, exercises, sports), constitute, with dietetics, the essential factors in the treatment of metabolic diseases (obesity, diabetes, gout, lithiasis).

6. As for the innumerable applications of *local hydrotherapy* (vaginal, rectal, cranial, etc.), the whole of clinical medicine would have to be reviewed in considering them, for there are hardly any disorders to which they are not more or less applicable.

7. It should not be forgotten that all hydrotherapeutic indications are subordinate to the *reactive capacities of the patients,* which experience alone can enable one to estimate. There are some "neuro-arthritic" subjects who exhibit to the cold hydrotherapeutic modalities such a degree of intolerance that one would be tempted to call it absolute, were it not that experience shows that, in these subjects as in all others, and in hydrotherapy, as in all other therapeutic procedures, all is a question of dosage and systematic training. This abnormal reactivity to hydrotherapy should be combatted, and along with it the accompanying morbid manifestations, by a process of training, habituation and hardening. That much skill, system and perseverance will be required for the purpose there is no doubt, but are these manifestations not precisely the ones most refractory to our treat-

ments, of whatever nature they may be—as are, indeed, all defects that may properly be called constitutional?

8. Particularly should it not be overlooked that **old persons** and cases of **arteriosclerosis, high blood-pressure, cardiac decompensation,** and **nephritis** either react poorly to cold or are subject to alarming high-pressure reactions. Cold water therapy is almost absolutely contraindicated in these cases. Even the other modalities should here be prescribed only with caution, and their application closely supervised. I might mention unfortunate accidents resulting from disregard of this rule and ignorance of this contraindication.

9. With *diet, hydrotherapy* and *myotherapy,* 95 per cent. of all morbid conditions can be treated.

COLD SPONGING.—This procedure is very simply carried out: With the patient lying on a bed, covered in such a way that the extremities and trunk may easily be exposed in succession, a towel or sponge dipped in water at 10 to 15° C. (50 to 59° F.) is drawn over one of these parts of the body. The *arm* is first dealt with, then the *chest,* next the *back,* and finally the *lower extremities.* Immediately after, the patient is wiped with a dry towel. The duration of the whole procedure should be four or five minutes.

This measure acts in two ways: First, by withdrawal of heat, it tends to produce a reduction of the temperature of the body; secondly, there is a tonic action of the cold water on the nervous system in general. At the moment of drying, by rubbing vigorously with a dry towel, one causes a stimulation of the nerves of the skin, thus enhancing the tonic effect. This procedure should be omitted in individuals whose nervous system is too irritable. Cold sponging is extensively availed of in *febrile infectious diseases.*

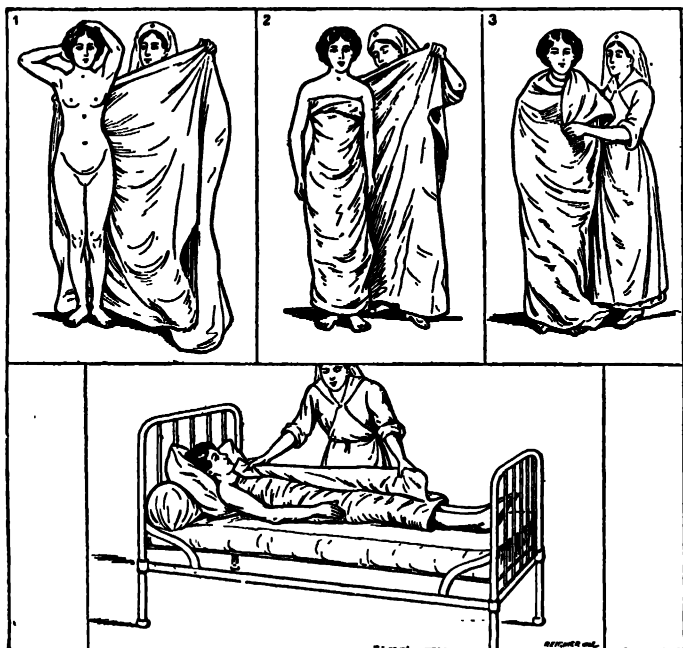
COLD COMPRESSES.—In order to obtain a refrigerant action more lasting than that secured by sponging, but less intense than is yielded by the use of ice, cold compresses should be employed. Such compresses are, for example, applied over the eyes in some cases of acute ophthalmia (application of ice over the eye might induce necrosis of the cornea).

In making such compresses, gauze folded to several thicknesses or old handkerchiefs are used. After being dipped in cold water they are quickly wrung out, unfolded and applied. Usually it is not necessary to cover the compresses with some impervious material preventing evaporation. The compresses should be renewed frequently.

COLD WET PACK.—The wet pack is used with much success to lower temperature in the *acute infectious diseases.* When applied for

but a short time, indeed, it induces a general vasoconstriction of the superficial vessels with rise of blood-pressure, withdrawal of heat and sedation of the nervous system; it may, therefore, be of service in *neuralgias* and *certain neuroses.*

Before starting to apply the cold wet pack it is well to cool the patient's forehead and head with cold water.



Figs. 4 to 7.—The wet pack.

The sheets are then removed and two woolen blankets spread over the mattress; over these is placed a sheet dipped in cold water and more or less completely wrung out; the patient is then placed in recumbency over the sheet, with his arms extended along the sides of the body, and wrapped in the wet sheet, the margins of which cross in front of his chest and are then carried around behind his back. The loose lower portion of the sheet is folded over the patient's feet, the woolen blankets similarly disposed, and a quilt may, if desired, be placed over all. The patient remains thus wrapped for

15 or 30 minutes. More prolonged applications have different indications.

CRYMOTHERAPY.—Crymotherapy (κρυμός, cold) or frigotherapy consists in the local therapeutic use of cold.

Its application requires merely a rubber bag filled with ice or a coiled rubber or metallic tube through which a current of very cold water is made to flow.

Deléarde and Louart, of Lille, have recorded temperature reductions of 4 or 5° C. (7.8 or 9° F.), even to 35° C. (95° F.) in some instances. The measure also exerts a tonic effect on the heart and raises the blood-pressure; in particular, it slows the rate of the heart.

Thus, in the acute infectious diseases crymotherapy fulfills three main indications: It combats high temperature, tones up the heart and

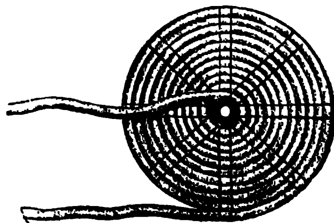


Fig. 8.—Coil for the application of cold to the precordium or epigastrium.

reduces tachycardia. It appears to be one of the best prophylactic measures available against infectious endocarditis and myocarditis. particularly those accompanying typhoid infection.

The precise manner in which it acts is as yet imperfectly known.

Cephalic crymotherapy, consisting of an ice-bag applied to or, a coil wound about the head, is a standard measure in acute meningitis, cerebral rheumatism and hyperemia of the brain.

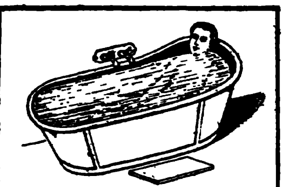
Cold applications to the nuchal region regularize cardiac action and respiration and subdue the genital reflexes. They are appropriate in idiopathic tachycardia, exophthalmic goiter, nervous asthma, priapism and nymphomania.

Cold over the dorsolumbar portion of the spine is sometimes employed in the irritable forms of neurasthenia and hysteria, in chorea, in acute spondylitis and in acute spinal meningitis.

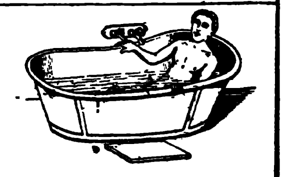
Precordial crymotherapy consists in placing an ice-bag over the heart region with one or more thicknesses of flannel interposed between it and the skin. The duration of the application is from several hours to several days.

Ordinary Modalities Without Percussion

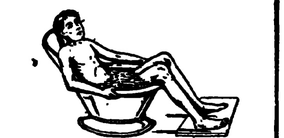
Full Bath.



Half Bath.



Local Bath.



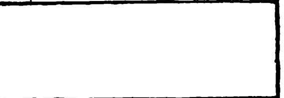
Affusions with the Sponge and Sprinkler.



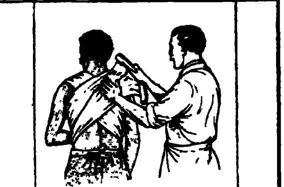
The Wet Sheet Pack.



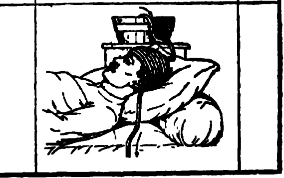




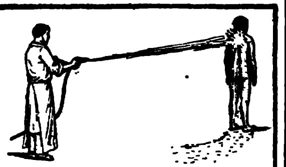
Application of Compresses.

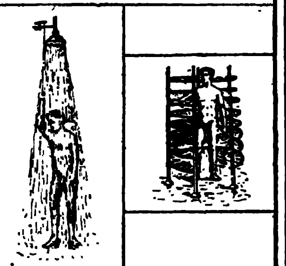


Coil.



and With Percussion.





Douches (local or general).

Applications of ice with a rubber ice-bag constitute true *frigotherapy*, often of marked value for *anti-pyretic* (precordial frigotherapy) and *antiphlogistic* purposes (meningitis, appendicitis, peritonitis, etc.).

Temperature.

Hot. 38 to 50° C.
(100.4 to 122° F.)

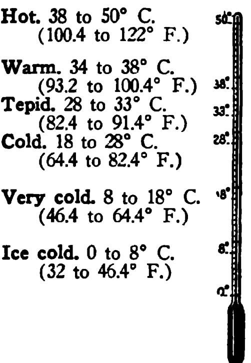
Warm. 34 to 38° C.
(93.2 to 100.4° F.)

Tepid. 28 to 33° C.
(82.4 to 91.4° F.)

Cold. 18 to 28° C.
(64.4 to 82.4° F.)

Very cold. 8 to 18° C.
(46.4 to 64.4° F.)

Ice cold. 0 to 8° C.
(32 to 46.4° F.)



The excitation and consequently the reaction produced vary according to the difference between the temperature of the procedure, whether hot or very cold, and the body temperature.

Three interesting thermic modalities are:

The **gradually cooled bath,** frequently employed for antipyretic purposes.

The **progressively warmed bath,** used in rheumatoid and circulatory manifestations.

The **alternating hot and cold douche** (Scotch douche), in which a cold douche abruptly follows a hot douche.

Duration.

The time occupied by an hydrotherapeutic application is dependent upon the temperature and modality applied, the power of the patient to react, and the nature of the disorder under treatment.

A. In a general way:
1. Douches and affusions are brief: A few seconds to one minute.
2. Baths are more or less prolonged: A few minutes to a half-hour or longer.
3. Packs and applications are almost always continued for several hours.

B. Similarly, in general:
1. The very hot or very cold modalities are applied for but a short time, with the exception of the frigotherapeutic modalities (ice-bag), used for antiphlogistic purposes.
2. The hot or cold modalities are of intermediate duration—a few minutes.
3. The tepid or indifferent modalities are applied for a period more or less prolonged, according to the effects desired.

C. On the whole, it is, however, the reacting power of the subject, and, consequently, observation of the effects obtained, which governs the duration, modality and temperature (see *Indications*).

In general:
1. *Tonic, stimulant effects are obtained with cold and brief applications.*
2. *Sedative, soothing effects are obtained with tepid and prolonged modalities.*
3. *Antiphlogistic effects are obtained with hot or cold applications more or less prolonged.*

Auxiliary Measures.

The natural auxiliaries of hydrotherapy are myotherapy (exercises, massage, swimming) and heliotherapy.

As strict hydrotherapeutic auxiliaries may be mentioned:

The numerous varieties of medicated baths: Carbon dioxide baths, sulphur baths, gelatin baths, starch baths, etc., each answering to special indications (see above).

The ice in the ice-bag is renewed as often as may be necessary.

This measure has two main indications:

The *infectious diseases,* and particularly, *typhoid fever.* The resulting reduction of temperature is much greater than one might suppose from the restricted surface covered by the ice-bag.

CRENOTHERAPY* [*from the Greek κρήνη, spring, treatment by mineral waters.*]

(*Written with the collaboration of A. MOUGEOT, M.D.*)

From the thermal standpoint, i.e., that of temperature, mineral waters may be grouped as:

Cold mineral waters, issuing at the same temperature as ordinary springs, up to 15° C. (59° F.).

Hypothermal waters, from 16 to 26° C. (60.8 to 78.8° F.).

Mesothermal waters, which may be directly used for baths, from 26 to 40° C. (78.8 to 104° F.).

Hyperthermal waters, above 40° C. (104° F.).

From the physical standpoint, there are four categories of waters:

(*a*) The *indifferent waters,* those the mineral content of which is too insignificant for especial characterization, and the therapeutic effects of which are evidently related to physical properties, such as temperature and radio-activity.

(*b*) The *mesothermal waters,* naturally charged with a large amount of free carbon dioxide, and which thus afford a special form of bath, the natural *carbon dioxide bath.*

(*c*) The *sodium chloride resorts,* where ingestion of the waters is now practically obsolete, and which are, therefore, *salt bath* resorts.

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*[In the French edition of this work the tabular matter in this section relates only to the mineral waters and resorts of France. For the benefit of the American reader it has seemed of possible interest, while preserving the more or less interesting details of the French tables, to introduce additional tables on the best known mineral springs of the United States and Canada, as well as a brief synopsis of the European waters and resorts other than those of France. The data presented have been obtained from the writings of Baruch, Huggard, Hinsdale, W. Anderson and S. T. Armstrong, to whom acknowledgment is hereby given.

In regard to the chemical compounds given as constituents of the different mineral waters in the tables, it should be noted that the actual chemical conditions in the waters are probably not as simple as one might infer, the prevailing belief being that where various acid and basic ions are present in solution "no base unites with any one acid to the exclusion of all other acids, or *vice versa,* but all possible combinations of the various basic and acid ions in solution are formed to some extent" (Haywood and Smith).

Again, it is necessary not to lose sight of the fact that the mineral ingredients in these waters often play only a minor rôle in the therapeutic results obtained, a large portion of the benefit derived from visiting thermal resorts being ascribable to more general factors relating to the mode of life, diet, and hygiene of the patient, together with improved climatic conditions. Radio-activity on the part of certain waters has also been held a possible source of benefit; this question, however, is still *sub judice.* Among the American waters found radio-active are those of Hot Springs, Ark., and of Glenwood Springs and Manitou, Colo.—TRANSLATOR.]

(*d*) Resorts having *mud baths* as a specialty.

From the chemical standpoint, the customary classification is certainly a very imperfect one. The well-known aphorism of Chaptal: "When you analyze a mineral water you are dissecting a cadaver," has much truth in it, as has been shown by late investigations on ionization and the radio-activity and physicochemical properties of solutions.

MINERAL WATERS OF THE UNITED STATES AND CANADA.

A. Thermal Waters.

GENERAL INDICATIONS.—These waters contain salts or gases in such small amount that any therapeutic virtues they may possess are generally ascribed to their temperature + a possible effect of the radioactivity + the more definite influences of change of air and environment, greater regularity of life and more strict adhesion to hygienic principles. The conditions in which they have been mainly recommended are chronic rheumatism, gout, neurasthenia, neuralgia, peripheral neuritis, paralyses of toxic or other origin, chronic skin diseases, syphilis, chronic constipation, chronic inflammatory states of the throat, stomach or intestines, nephritis in its earlier stages, chronic pyelitis and chronic cystitis.

NAME OF SPRINGS AND ALTITUDE.	TEMPERATURE. (Fahrenheit.)	SOLIDS. (grains per gallon.)	CHIEF OR SPECIAL CONSTITUENTS.
Hot Springs, Arkansas. (718 ft.)	93°-157°	8.55	Calcium carbonate. Silica. Alumina. Free H_2S and CO_2.
Agua Caliente, California. (725 ft.)	58°-142°	39.3	Sodium chloride. Sodium carbonate.
Calistoga Hot Springs, California. (331 ft.)	95°-195°	37.50	Sodium chloride. Calcium chloride. Calcium carbonate. Silica. Magnesium sulphate. Sodium sulphate. Free H_2S.
Mono Basin Warm Springs, California. (6730 ft.)	85°-90°	2.08	Sodium carbonate. Sodium sulphate. Sodium chloride. Magnesium bicarbonate.

THERMAL WATERS (*continued*).

NAME OF SPRINGS AND ALTITUDE.	TEMPERATURE. (Fahrenheit.)	SOLIDS. (grains per gallon.)	CHIEF OR SPECIAL CONSTITUENTS.
Cañon City Hot Springs, Colorado. (5442 ft.)	104°	0.40	Calcium carbonate. Sodium chloride. Magnesium carbonate.
Idaho Hot Springs, Colorado.	85°-115°	107.12	Sodium carbonate. Sodium sulphate. Magnesium sulphate. Calcium carbonate. Ferrous carbonate.
Warm Springs, Georgia.	90°	147.68	Magnesium salts. Calcium salts. Iron salts. Free CO_2.
Warm Springs, North Carolina. (1325 ft.)	97°	78.49	Calcium sulphate. Silicates. Calcium chloride. Sodium sulphate. Magnesium sulphate. Free CO_2 and H_2S.
Des Chutes Hot Springs, Oregon.	143°-145°	77.62	Sodium carbonate. Sodium chloride. Sodium sulphate. Free CO_2.
Healing Springs, Virginia.	85°-88°	35.72	Calcium carbonate. Magnesium sulphate. Potassium sulphate. Calcium sulphate.
Hot Springs, Virginia.	102°-110°	33.36	Calcium carbonate. Magnesium sulphate. Magnesium carbonate. Calcium sulphate.

B. Carbonated (Acidulous) Waters.

General Indications.—These waters contain large quantities of carbonic acid (carbon dioxide) gas, which is deemed to account for their effects, rather than the rather insignificant amounts of mineral ingredients they contain. They cause a slight general exhilaration through stimulation of the nerve-endings of the tongue, palate and stomach by the gas set free. In the stomach they also stimulate peristalsis. They have been recommended mainly in gastric disorders, to relieve nausea, increase appetite, and promote digestion and motility. In the form of baths, they are deemed serviceable in pruriginous and hyperesthetic conditions of the skin and in cases of circulatory weakness that have not reached an advanced stage.

CARBONATED WATERS.

NAME OF SPRINGS.	SOLIDS. (grains per gallon.)	CONTENT OF CO_2 (cu. inches per gallon.)	CHIEF MINERAL CONSTITUENTS (in quantitative order.)
Bladen Vichy Spring, Alabama.	52.49	65.44	Sodium carbonate. Calcium sulphate. Calcium carbonate.
Summit Soda Spring, California.	92.16	187.25	Calcium bicarbonate. Sodium chloride. Calcium carbonate. Sodium carbonate.
Blue Lick Spring, Kentucky. (Lower.)	632.84	98.80	Sodium chloride. Calcium sulphate. Magnesium chloride. Calcium carbonate. Potassium sulphate.
Old Sweet Springs, West Virginia.	60.69	88.00	Calcium carbonate. Calcium sulphate. Magnesium sulphate. Sodium sulphate.

C. Sulphur Waters.

General Indications.—These waters contain hydrogen sulphide in considerable amount, as well as varying mixtures of the sulphides of the alkalies and alkaline earths. There has been much doubt as to their mode of action; plausibly, they may act on the intestinal canal, stimulating the glandular functions and producing laxative effects. Biliary secretion is said to be increased. If used to excess, they promote constipation and lead to anemia and weakness. Their internal use has been recommended in hepatic congestion, engorgement of the pelvic viscera, hemorrhoids, constipation, chronic intestinal catarrh, and chronic poisoning by lead or mercury. Chronic pharyngeal, laryngeal, bronchial and gastric catarrhs have also been considered indications; likewise asthma, acne, eczema and psoriasis. The utility of these waters in syphilis is doubtful. Sulphur baths and inhalations are used with asserted benefit in chronic rheumatic conditions and gout.

SULPHUR WATERS.

NAME OF SPRINGS.	SOLIDS. (grains per gallon.)	CONTENT OF H_2S. (cu. inches per gallon.)	CHIEF MINERAL CONSTITUENTS (in quantitative order.)
Blount Springs, Alabama. (Red Sulphur Spring.)	53.04	14.96	Sodium chloride. Calcium carbonate. Magnesium chloride. Magnesium carbonate.
St. Helena White Sulphur Springs, California.	36.69	6.15	Sodium chloride. Sodium sulphate. Sodium sulphide. Calcium chloride.
Santa Barbara Sulphur Springs, California.	35.95	9.16	Sodium sulphate. Magnesium sulphate. Calcium sulphate. Aluminium sulphate.
French Lick Springs, Indiana. (Pluto's Well.)	255.47	25.44	Sodium chloride. Calcium sulphate. Sodium sulphate. Magnesium sulphate. Free CO_2, 14.96 cu. in.
Blue Lick Springs, Kentucky. (Lower.)	632.84	18.24	Sodium chloride. Calcium sulphate. Magnesium chloride. Calcium carbonate. Free CO_2, 98.80 cu. in.
Paroquet Springs, Kentucky.	442.41	30.00	Sodium chloride. Calcium chloride. Magnesium chloride. Free CO_2, 6.00 cu. in.
Alpena Well, Michigan.	189.26	35.36	Sodium chloride. Calcium carbonate. Magnesium carbonate. Calcium sulphate. Free CO_2, 8.40 cu. in.
Avon Springs, New York. (Upper Spring.)	136.40	12.00	Calcium sulphate. Sodium chloride. Sodium sulphate. Free CO_2, 5.60 cu. in.
Richfield Springs, New York.	225.50	2.64	Magnesium sulphate. Calcium sulphate. Magnesium carbonate.
Sharon Springs, New York. (White Sulphur Spring.)	160.88	16.00	Calcium sulphate. Magnesium sulphate. Sodium sulphide. Calcium sulphide.

SULPHUR WATERS (*continued*).

NAME OF SPRINGS.	SOLIDS. (grains per gallon.)	GASES. (cu. inches per gallon).	CHIEF MINERAL CONSTITUENTS (in quantitative order.)
Buffalo Springs, Virginia.	15.40	1.20	Magnesium sulphate. Calcium sulphate. Ferrous sulphate.
Jordan's White Sulphur Springs, Virginia.	20.85	2.00	Potassium carbonate. Calcium sulphate. Magnesium carbonate.
Greenbrier White Sulphur Springs, West Virginia.	129.66	0.24	Calcium sulphate. Magnesium sulphate. Calcium carbonate. Free CO_2, 11.28 cu. in.
Salt Sulphur Springs, West Virginia. (Iodine Spring.)	172.49	19.12	Calcium sulphate. Calcium carbonate. Sodium sulphate. Bromine (0.65 grain to gall.) Iodine (0.63 grain to gall.) Free CO_2, 34.56 cu. in.

D. Alkaline and Alkaline-saline Waters.

General Indications.—The alkaline waters have as chief constituents the alkaline carbonates, especially of sodium. The alkaline-saline waters contain, in addition, active amounts of sodium or magnesium sulphate. The alkaline salts, upon absorption, reduce acidity of the tissue fluids, and up to a limit, activate oxidation and tissue-metabolism. Mucous membranes throughout the body are asserted to be stimulated. The indications generally specified include catarrhal conditions of the stomach, hyperchlorhydria, infections of the urinary tract (unless the urine is already alkaline), cholelithiasis and nephrolithiasis, rheumatism and gout, chronic catarrhal conditions in the respiratory tract, and eczema or psoriasis with acid tendencies. To the waters containing sodium sulphate added power to stimulate the biliary tract has been ascribed. The effect of flushing with an excess of water is generally recognized as taking part in the systemic action of these and other mineral waters.

ALKALINE AND ALKALINE-SALINE WATERS.

NAME OF SPRINGS.	SOLIDS. (grains per gallon.)	GASES. (cu. inches per gallon.)	CHIEF MINERAL CONSTITUENTS (in quantitative order.)
Bladen Springs, Alabama. (Vichy Spring.)	52.50	CO_2: 65.44 Cl_2: 1.84	Sodium carbonate. Calcium sulphate. Calcium carbonate.
California Seltzer, California.	187.15	CO_2: 18.0	Calcium carbonate. Sodium bicarbonate. Magnesium carbonat.
Geyser Spa, California. (200° F.)	58.57	CO_2: saturated.	Sodium bicarbonate. Magnesium bicarbonate. Sodium chloride. Sodium carbonate.
Ukiah Vichy Springs, California. (93° F.)	268.45	CO_2: 224.75	Sodium carbonate. Sodium chloride. Magnesium carbonate. Calcium carbonate.
Manitou Springs, Colorado.	100.00	—	Calcium bicarbonate. Sodium bicarbonate. Sodium chloride. Sodium sulphate.
St. Louis Springs, Michigan.	176.05	CO_2: 10.88 H_2S: trace	Sodium carbonate. Calcium sulphate. Calcium carbonate. Magnesium carbonate. Ferrous carbonate.
Ballston Spa, New York. (Artesian Lithia Well.)	1079.74	CO_2: 426.08	Sodium chloride. Calcium carbonate. Magnesium carbonate. Potassium chloride. Lithium carbonate.
Saratoga Springs, New York. (Hathorn.)	888.40	CO_2: 575.75	Sodium chloride. Calcium bicarbonate. Magnesium bicarbonate. Barium bicarbonate. Lithium bicarbonate.
Saratoga Springs, New York. (Vichy.)	315.177	CO_2: 383.07	Sodium chloride. Sodium bicarbonate. Calcium bicarbonate. Magnesium bicarbonate. Lithium bicarbonate.
Gettysburg Spring, Pennsylvania.	32.54	—	Calcium bicarbonate. Magnesium sulphate. Sodium sulphate.
Minnequa Spring, Pennsylvania.	10.76	—	Calcium bicarbonate. Magnesium bicarbonate. Sodium bicarbonate.
Capon Springs, West Virginia.	12.14	CO_2: 8.57 N_2: 3.68 O_2: 1.76	Calcium carbonate. Magnesium carbonate. Calcium sulphate. Sodium carbonate.

E. Sodium Chloride Waters.

General Indications.—The sodium chloride or muriated saline waters depend for their action mainly on sodium chloride, but may contain other salts exerting an additional purgative effect. Among the chief conditions for which they have been recommended are gastric atony with subacidity or anacidity, gastric hyperacidity, chronic intestinal catarrh with constipation, and obesity. Von Noorden and Dapper reported from their use a lasting increase in HCl production in the first-mentioned group of cases, but a decrease of HCl production in cases with hyperacidity, especially in nervous dyspepsia. They have also been used in gouty and rheumatic conditions to promote excretion of uric acid. Needless to state, they should be avoided in nephritis.

The waters of Ballston Spa and Saratoga, N. Y., belong both in the present and preceding groups, and some of their springs have already been referred to. The water of St. Catherine's Well, Ontario, Canada, has an exceptional content of sodium chloride and has been included in the present section, as well as two other Canadian springs.

NAME OF SPRINGS.	SOLIDS. (grains per gallon.)	GASES. (cu. inches per gallon).	CHIEF MINERAL CONSTITUENTS (in quantitative order.)
Eureka Springs, California.	1800.27	H_2S: saturated CO_2: small amt.	Sodium chloride, 1403. Magnesium sulphate. Magnesium chloride.
Glenwood Springs, Colorado. (Yampah Spring.)	1250.04	—	Sodium chloride, 1090. Calcium sulphate. Calcium bicarbonate. Potassium sulphate.
Blue Lick Springs, Kentucky. (Upper.)	660.19	CO_2: 48.16 H_2S: 8.16	Sodium chloride, 516. Calcium sulphate. Magnesium chloride.
Fruit Port Well, Michigan.	695.77	—	Sodium chloride, 464. Calcium chloride. Magnesium chloride. Sodium sulphate.
Mt. Clemens Spring, Michigan.	13,653.32	H_2S: 40.00 CO_2: 5.80	Sodium chloride, 11,900. Calcium chloride, 934. Magnesium chloride, 648
Excelsior Spring, Syracuse, New York.	668.24	—	Sodium chloride, 584.

SODIUM CHLORIDE WATERS (*continued*).

NAME OF SPRINGS.	SOLIDS. (grains per gallon.)	GASES. (cu. inches per gallon.)	CHIEF MINERAL CONSTITUENTS (in quantitative order.)
Glen Springs, New York. (Neptune Spring.)	10,503.08	—	Sodium chloride.
Saratoga Springs, New York. (Congress Spring.)	700.89	CO_2: 392.29	Sodium chloride, 400. Calcium bicarbonate, 143. Magnesium bicarbonate, 122. Sodium bromide, 8.5.
Saratoga Springs, New York. (Kissingen Spring.)	644.63	CO_2: 361.50	Sodium chloride, 338. Calcium carbonate, 140. Magnesium bicarbonate, 70. Lithium bicarbonate, 5.1.
Caledonia Springs, Ontario, Canada.	453.36	CO_2: 40.0	Sodium chloride, 406. Magnesium carbonate. Calcium carbonate.
Sandwich Springs, Ontario, Canada.	378.33	H_2S: 37.76 CO_2: 10.00 N_2: 0.72	Magnesium chloride, 154.. Calcium sulphate. Sodium carbonate. Calcium carbonate.
St. Catherine's Wells, Ontario, Canada. (Welland House Well.)	3597.22	—	Sodium chloride, 2207. Calcium chloride, 1018. Magnesium chloride. Calcium sulphate.

F. Bitter or Purgative Waters.

General Indications.—These waters contain a large proportion of sodium sulphate, magnesium sulphate, or both. They are much used in constipation, especially in plethoric persons, and may also be availed of in hepatic congestion, cholelithiasis, gastric catarrh, pelvic congestion, hemorrhoids, and obesity. They have also been considered indicated in some cases of rheumatism or gout. In anemic individuals they should be used only with caution.

The French Lick (Pluto), Ind., and Avon and Richfield Springs, N. Y., belong partly in other groups and have already been listed.

BITTER OR PURGATIVE WATERS.

NAME OF SPRINGS.	SOLIDS. (grains per gallon.)	GASES. (cu. inches per gallon).	CHIEF MINERAL CONSTITUENTS (in quantitative order.)
Castalian Springs, California.	4422.25	—	Sodium chloride. Sodium carbonate. Sodium sulphate, 651. Potassium chloride.
Abilena Spring, Kansas.		—	Sodium sulphate. Magnesium sulphate. Calcium sulphate. Sodium chloride.
Crab Orchard Springs, Kentucky. (Foley's Spring.)	401.46	—	Magnesium sulphate, 205. Sodium sulphate, 59. Calcium carbonate. Sodium chloride.
Harrodsburg Springs, Kentucky. (Saloon Spring.)	344.08	—	Magnesium sulphate, Calcium sulphate, 82. Calcium carbonate.
Bedford Springs, Pennsylvania.	153.30	CO_2: 74.0	Calcium sulphate, 100. Magnesium sulphate, 40. Calcium carbonate.

G. Alkaline-calcareous (Earthy) Waters.

General Indications.—These waters, the characteristic component of which is calcium carbonate or sulphate, have long been a subject of controversy. One cannot expect much absorption of the calcium, but strong claims of beneficial results from such waters in bladder catarrh and gravel have been made. One might expect the carbonate to undergo absorption more freely than the sulphate, but some of these waters contain also sodium bicarbonate, to which any clinical effects noted might instead be ascribed. These waters have also been considered beneficial in affections of the biliary tract, gout and rheumatism, skin disorders, rickets and pulmonary tuberculosis. According to Von Noorden, calcium combines with phosphoric acid in the intestine, and by preventing its absorption promotes alkalinity of the urine. In the stomach these waters tend to counteract hyperacidity. Some of the calcareous waters are cold, others thermal, such as those of Hot Springs, Ark.

The waters of Hot Springs, Ark.; Manitou, Colo.; Bedford, Pa., and Greenbrier White Sulphur Springs, W. Va., which are in part calcareous waters, have already been listed in preceding groups.

ALKALINE-CALCAREOUS WATERS.

NAME OF SPRINGS.	SOLIDS. (grains per gallon.)	GASES. (cu. inches per gallon).	CHIEF MINERAL CONSTITUENTS (in quantitative order.)
Alum Rock Springs, California.	62.21	CO_2: excess.	Calcium carbonate, 19. Sodium chloride. Magnesium carbonate. Magnesium sulphate. Alumina.
Catoosa Springs, Georgia.	99.15	CO_2: 9.72	Calcium sulphate, 45. Magnesium sulphate. Magnesium carbonate. Calcium carbonate.
Cherry Valley Spring, New York.	140.71	—	Calcium sulphate, 57. Magnesium sulphate. Magnesium carbonate. Sodium chloride.
Chittenango Springs, New York. (Magnesia Spring.)	143.97	CO_2: 18.4 H_2S: 12.8	Calcium sulphate, 115. Magnesium sulphate. Magnesium carbonate. Sodium chloride. Calcium sulphide.
Clifton Springs, New York.	133.68	CO_2: Abundant H_2S: Abundant	Calcium sulphate, 69. Magnesium sulphate. Magnesium carbonate. Calcium carbonate, 10.
Healing Springs, Virginia. (88° F.)	35.72	CO_2: 4.80	Calcium carbonate, 19. Magnesium sulphate. Potassium sulphate. Magnesium carbonate.

H. Chalybeate (Iron) Waters.

General Indications.—These waters contain either ferrous sulphate or carbonate, generally combined with more active constituents. The ferrous sulphate waters are usually less palatable and more astringent than the ferrous carbonate waters, and frequently contain alum in addition. The indications are in most respects those of iron in general, comprising anemia, chlorosis, and various other conditions when accompanied by anemia, such as amenorrhea, neurasthenia, chronic nephritis, diabetes mellitus and nervous dyspepsia. The more astringent waters have yielded benefit in chronic diarrhea, gastric ulcer, gout, rheumatism, malarial cachexia, eczema and psoriasis. Hysteria, hypochondriasis, neuralgias and other neuroses, when attended with anemia or debility, are likely to show favorable results.

CHALYBEATE WATERS.

NAME OF SPRINGS.	SOLIDS. (grains per gallon.)	GASES. (cu. inches per gallon).	CHIEF MINERAL CONSTITUENTS (grains per gallon).
Napa Soda Springs, California.	67.15	CO_2: 143.62	Magnesium carbonate. Sodium bicarbonate. Calcium carbonate. Ferrous carbonate, 8.
Pacific Congress Springs, California.	334.27	CO_2: 44.17	Sodium carbonate. Sodium chloride. Magnesium carbonate. Ferrous carbonate, 14.
Manitou Springs, Colorado. (Iron Ute Spring.)	340.0	—	Sodium carbonate. Calcium carbonate. Sodium chloride. Sodium sulphate. Ferrous carbonate, 9.
Oak Orchard Spring, New York.	211.21	—	Calcium sulphate. Magnesium sulphate. Ferrous sulphate, 33. Aluminium sulphate, 6.
Ballston Spa, New York.	247.15	—	Sodium chloride. Calcium carbonate. Magnesium bicarbonate. Ferrous carbonate, 6.
Saratoga Springs, New York. (Putnam Spring.)	361.01	CO_2: 348.88	Sodium chloride. Calcium bicarbonate. Magnesium bicarbonate. Ferrous bicarbonate, 7.
Sharon Springs, New York. (Chalybeate Spring.)	114.53	—	Calcium sulphate. Magnesium carbonate. Magnesium sulphate. Ferrous sulphate, 1.4.
Cresson Springs, Pennsylvania. (Iron Spring.)	108.39	—	Calcium sulphate. Magnesium sulphate. Ferrous sulphate, 23. Ferrous bicarbonate, 5.

CHALYBEATE WATERS (*continued*).

NAME OF SPRINGS.	SOLIDS. (grains per gallon.)	GASES. (cu. inches per gallon.)	CHIEF MINERAL CONSTITUENTS (grains per gallon.)
Kittanning Mineral Springs, Pennsylvania.	—	—	Calcium sulphate. Ferrous sulphate, 24.
Bedford Alum Springs, Virginia.	92.17	—	Ferrous sulphate, 23. Calcium sulphate. Magnesium sulphate. Potassium sulphate. Aluminium sulphate, 7.
Church Hill Alum Springs, Virginia.	426.70	—	Calcium sulphate. Magnesium sulphate. Ferric bisulphate, 83. Aluminium persulphate, 73. Ferric persulphate, 51.
Rawley Springs, Virginia.	5.15	CO_2: 6.16	Ferrous carbonate, 1.6. Magnesium carbonate. Silica. Sodium sulphate.
Rock Enon Springs, Virginia.	40.43	—	Ferrous carbonate, 14. Magnesium sulphate. Calcium carbonate. Manganese carbonate, 1.
Rockbridge Alum Springs, Virginia.	46.40	CO_2: 8.80	Alumina, 24. Ferrous oxide, 5. Magnesium sulphate. Calcium sulphate.

MINERAL WATERS AND RESORTS OF FRANCE.

A. Waters Chemically Indefinite, but Thermal and Radio-active.

GENERAL INDICATIONS: Relief of pain in rheumatism and gout, neuralgias, neuritis and multiple neuritis; sedative effect in neurasthenia with irritability and in hysteria.

CONTRAINDICATIONS TO THE HYPERTHERMAL WATERS: Nervous depression, tabes dorsalis, arteriosclerosis, threatened cerebral hemorrhage, etc.

RESORTS AND ELEVATIONS.	SPRINGS AND TEMPERATURES.	SOLIDS. (grams per liter.)	RADIO-ACTIVITY*.	MODES OF ADMINISTRATION.	SPECIAL INDICATIONS.
Aix-les-Bains (Savoie), (820 ft.)	Sulphur: 113° F. Alum: 114.8°.	—	N = 0.68	Douche with massage.	Pain in uricemia.
Bagnoles-de-l'Orne.	Grande Source Thermale: 78.8°	Na_2SO_4: 0.12 Silica: 0.013 NaCl: 0.016	N = 0.36 H ?	Baths + massage + rest cure.	Varicose veins, long-standing phlebitis, varicocele, hemorrhoids, prostastic congestion.
Bagnols (Lozère). (2820 ft.)	95° to 107.6°	0.7932 Calcium sulphide.	?	—	—
Bains-les-Bains (Vosges).	Grande Source: 122°. Source tiède: 91.4°.	0.30 Alkaline salts.	N = 1.76. H = 0.198	Baths with special jet under water.	Uricemia; enterocolitis.
Balaruc (Hérault).	Source Romaine: 118.4°.	10.26 NaCl: 7.04.	—	—	Paralytic states.

Bourbon-Lancy (Saône-et-Loire).	Lymbe: 136.4° Descures: 129.2° La Reine: 120.7°	1.80 NaCl: 1.30	N = 1.03 H = 1.84 (Lymbe).	Baths with special jet under water.	Rheumatic endocarditis; nervous tachycardia.
Bourbon-l'Archambault (Allier).	125.6°	3.98 NaCl: 2.24	—	—	Scrofula; cerebral paralyses.
Bourbonne-les-Bains (Haute-Marne).	149°	7.33 NaCl: 5.20 $LiCl_2$: 0.088 NaBr: 0.065	—	—	Sequelæ of trauma, joint swellings, muscular pains, etc.
Chaudesaigues (Cantal) (2130 ft.).	179.6°	0.811 Na_2CO_3: 0.471	?	—	—
Luxeuil (Haute-Saône).	86° to 132.8°	1.32	N = 0.62 H = 0.87 (Bains des Dames).	Vaginal irrigations	Uterine disorders.
Néris (Allier) (850 ft.)	Grand Puits: 126° Puits de la Croix: 124.2°	1.265	N = 0.46 H = 1.06	Baths of indifferent temperature and of increasing duration (10 to 60 minutes). Sedative.	Hysteria; organic nervous diseases with spasms.
Plombières (Vosges).	104° to 165.2°	0.28	N = 3.08 to 5.50 H = 0.104 to 0.292	—	Enteritis with spasm or diarrhea: uterine disorders.

* The unit of radio-activity, N, represents the number of minutes during which 1 milligram of pure radium bromide would have to be allowed to act on 10 liters of air in order to obtain an emanation charge equal to that existing in the same volume of the gases withdrawn from the spring under consideration (Moureu).
The quantity of helium, H, is the percentage of helium in the gases spontaneously set free.

B. Mesothermal Resorts Affording Carbonated Baths.

GENERAL INDICATIONS: Circulatory disturbances, high blood-pressure, incipient heart weakness, emphysema, exophthalmic goiter, uricemia, anemia, peripheral nervous disturbances, tabes dorsalis, neurasthenia.

CONTRAINDICATIONS: Aortic aneurism, pronounced angina pectoris, heart failure, advanced myocarditis.

RESORTS AND ELEVATIONS.	SPRINGS AND TEMPERATURES.	CO_2 CONTENT.		FLOW IN 24 HOURS.	MODES OF ADMINISTRATION.	TEMPERATURE OF BATH.	SPECIAL INDICATIONS.
		per liter.	*by volume.*				
Châteauneuf (Puy-de-Dôme). (1210 ft.)	Grand Bain (hot): 99.5° F. Warm bath: 96.8° Bain Julie: 89.6° Bain Marie-Louise: 91.4° Rotonde: 84.2° Bain Auguste: 82.4°	1.195 1.318 1.457 1.579 1.730 1.109	—	300,000 liters 200,000 " 45,000 " 200,000 " — 35,000 "	Baths, and especially bathing pools with running water.	96.8° F. 95° 89.6° 91.4° 82.4°	Rheumatic conditions.
Châtelguyon (Puy-de-Dôme). (1280 ft.)	—	1.112	74%	—	Baths with running water.	89.6° 82.4°	Abdominal and hepatic stasis in constipated, enteritic or dyspeptic subjects.

Lamalou (Hérault) (620 ft.)	Source ancienne: 86° to 91.4°	1.470	74.2%	354,000 liters	Several bathing pools.	About 100° 97°, 91° and 88°	Tabes dorsalis, flaccid paraplegias, myelitis, etc.
	Sources nouvelles: 93.2° to 120.2°	0.646	32.6%				
	Source des Bains: 84.2°		69.2%	480,000 "	Bathing pools and tubs.	82.4°	
Royat (Puy-de-Dôme). (1475 ft.)	Eugénie: 95.9°	0.377	25%	1,440,000 "	Baths and pools with running water.	93°	High blood-pressure (uricemia, aortitis, menopause). Functional heart disturbances.
	Saint-Mart: 87.8°	1.709	107%	225,000 "		86°	
	César: 84.2°	1.229	85%	34,000 "	Do.	80.6°	
Saint-Nectaire (Puy-de-Dôme). (2460 ft.)	Mont-Cornadore: 105.8°	0.964	63%	79,000 "	Tubs with running water.	100.4°	Albuminuria.
	Boële	1.059	70%				
	Césaire	0.860	57%	200,000 "	Do. (Grands Thermes).	100.4°	
	Gubler	0.680	46%				
	Gros Bouillon / Coquille	1.29	86%	—	Do. (Bains Romains).	93.2 to 95°	
Salins-Moutiers (Savoie) (1615 ft.)	96.8°	0.385	26%	6,000,000 "	Baths with running water.—1.25 per cent. of chlorides.	95.9°	Scrofulosis, lymphatism, uterine disorders, fatty infiltration of heart.

C. Chloride Baths.

GENERAL INDICATIONS: Scrofula, lymphatism, tuberculosis of bones, joints or lymph-nodes; uterine fibromyoma, metritis.

	Resorts and Elevations.	Temperature and Specific Gravity.	Solids. (grams per liter).	NaCl.	Other Salts.	Modes of Administration.	Special Indications.
Stronger Waters.	**Biarritz-Briscous** (Basses-Pyrénées).	Temp.: 57.2° F. Areometric reading: 24° Brine: Areometric reading: 28-35°	307.79 418.4	295.66 99.9	NaBr: 0.167 Iodides: trace. Bromides: 10.215 Iodides: 0.013 $MgCl_2$: 257	External treatment exclusively.	Associated marine climate and sea bathing. Children.
	La Mouillère-Besançon	Temp.: 51.8° Areometric reading: 24°	298	233	KBr: 0.108	External treatment exclusively.	
	Salies-de-Béarn (Basses-Pyrénées). (1970 ft.)	Temp.: 59° Areometric reading. 22-24°	258	245	NaBr: 0.162	Brine compresses.	Fibromyomas.
	Salins (Jura).	Puits à Muire: Temp.: 53.6° Areometric reading: 3.6° Brine.	26 318.5	22.7 168	$MgCl_2$: 0.87 KCl: 0.25 KBr: 0.03 $MgCl_2$: 60 KBr: 2.84	External treatment exclusively.	—
Milder Waters.	**Balaruc.**	Source Romaine: 118.4°	10.26	7.04			
	Bourbonne-les-Bains.	149°	7.33	5.2			
	Lamotte-les-Bains (Isère).	Le Puits: 140°	7.50	3.80			
	Santenay (Côte-d'Or) (920 ft.)	Fontaine-Salée: 50.9°	9.19	5.5	$LiCl_2$: 0.09 $NaSO_4$: 2.15	—	Gout.
	Salins-Moutiers.	Source-Lithium: 64.4° 96.8°	16.69	12.5		Carbonated baths.	

D. Natural Mud Baths.

GENERAL INDICATIONS: Chronic polyarticular rheumatism; deforming, gouty, fibrous or nodose rheumatism; arthritis sicca; etc.; chronic muscular rheumatism, gonorrheal rheumatism and other joint conditions.

GENERAL CONTRAINDICATIONS: Acute rheumatism, arteriosclerosis, heart disorders, chlorotic anemia, tuberculosis, nephritis, diabetes.

RESORTS.	NATURE AND SOURCE OF THE MUD.	COMPOSITION.	SPECIFIC GRAVITY.	MANNER OF USE.	SPECIAL INDICATIONS.
Balaruc.	Mud from the Thau pond soaked with the thermal water for several months.	—	—	Local uses only.	Tuberculosis of bones and lymphatics.
Barbotan. (Gers).	Natural vegetable and mineral mud mixed with sulphurous mineral water at 96.8° F.	47% organic matter. 52% mineral matter, including { Silica: 32%. Alumina: 13.4%. H_2S: 0.065 per liter. }	—	Baths at 96.8° F.	All rheumatic conditions, even when combined with cardiovascular lesions. Phlebitis.
Dax (Landes).	Vegetable and mineral mud deposited by the Adour River and crossed by the mineral springs at 140° F.	Contains sulphates, magnesia, iron, sulphides and traces of bromides and iodides.	—	Tub or partial baths at 96.8 to 104°; local applications at 104 to 113°.	Surgical conditions: Hydrarthrosis, stiff joints, peri-articular hyperemia, and secondary muscular atrophy.
Saint-Amand (Nord).	Natural mineral mud, in 3 layers: Black ferruginous earth. Clayey marl. Shifting, sulphurous sand. Crossed by mineral springs at 78.8°.	Contains sulphates, lime, magnesia and sulphides.	1.15 to 1.53	Local applications at 113 to 131°.	Phlebosclerosis and chronic perimetritis and perityphlitis.

E. Strong Sodium Bicarbonate Waters.

GENERAL INDICATIONS: Dyspepsias, especially with hyperchlorhydria and hypermotility, cholelithiasis, congestion of the liver, diabetes with excessive urinary nitrogen due to overnutrition, established gout.

RESORTS.	SPRINGS AND TEMPERATURES.	SODIUM BICARBONATE. (grams per liter).	OTHER SALTS. (grams per liter).	TOTAL SOLIDS.	SPECIAL INDICATIONS.
Vals (Ardèche). (850 ft.)	La Marquise: 55.4° F.	7.10	Sodium chloride: 0.1 Sodium sulphate: 0.2	—	Same as Vichy.
	Rigolette.	5.80	—		
	Dominique.	—	Sodium arsenate: 0.003		
	Saint-Jean.	1.43	—		
Vichy (Allier). (785 ft.)	Grande Grille: 111.2°	4.8	Sodium chloride: 0.5 Sodium arsenate: 0.002	—	Malaria. Cholelithiasis. Non-hemorrhagic ulcers.
	Hôpital: 87.8°	5	Sodium chloride: 0.5 Sodium arsenate: 0.002		
	Célestins: 53.6°	5.1	Sodium chloride: 0.5 Sodium sulphate: 0.2 Sodium arsenate: 0.002		
Andabre (Aveyron). (1475 ft.)	Source de la Buvette: 50° F.	3.17	Iron (carbonate): 0.018	—	Dyspeptic disturbances in chlorotic anemia.

F. Weak Sodium Bicarbonate, Mixed Bicarbonate, and Calcium Bicarbonate Waters.

GENERAL INDICATIONS: Dyspepsia with hypochlorhydria, hypomotility; neuromotor, nervous and neurasthenic dyspepsias.

RESORTS.	SPRINGS AND TEMPERATURES.	BICARBONATE OF SODIUM.	OF CALCIUM.	OF MAGNESIUM.	OTHER SALTS.	TOTAL SOLIDS.	FREE CO_2.	SPECIAL INDICATIONS.
Aix-en-Provence.	Sextius: 95° F.	0.03	0.10	0.02		0.254	9 c.c.	Edema.
Alet (Aude).	Buvette and Communale: 89.6 and 95°	-	0.40	0.16	—	0.52 0.48	—	—
Le Boulou (all year).	4 springs: 60.8 to 66.2°	3.32	—	—	—	—	—	Urinary disorders; tropical diarrhea.
Capvern (Hautes-Pyrénées).	Haount Caoude: 75.2° Bouridé: 71.2°	—	+	+	+	—	—	Diuresis cure.
Châteauneuf.	Source Lefort: 96.8° Source Petit-Rocher: 77°	2.080 0.915	0.350 0.408	0.192 0.175	— Iron bicarb. 0.428	— —	1.050 1.155	—
Pougues (Nièvre).	Saint-Léger: 53.6°	0.8	2	—	—	4.53	3.39	Phosphaturia and oxaluria.
Saint-Nectaire.	Mont Cornadore. Source des Dames.	2.313 2.580	0.653 0.452	0.539 0.257	—	—	0.708 0.743	Dyspepsia with albuminuria.

G. Thermal Alkaline and Chloride Waters.

General Indications: Catarrhal affections of the respiratory tract, even of congestive type, in which sulphur resorts are dangerous; uricemia.

Resorts and Elevations.	Springs and Temperatures.	Solids. (grams per liter).	Bicarbonates. (grams per liter).	Sodium Chloride. (grams per liter).	Other Salts. (grams per liter).	Special Indications.
La Bourboule (Puy-de-Dôme) (2790 ft.)	Choussy-Perrière: 138.2° F.	6.50	Sodium: 2.892	2.838	Sodium arsenate: 0.028	Pretuberculosis, infantile asthma, tracheo-bronchial adenopathy.
Le Mont-Dore (Puy-de-Dôme) (3445 ft.)	12 springs: 100.4 to 116.6°	2 to 3	Sodium: 0.55 Calcium: 0.37	—	Silica: 0.16	Spasmodic respiratory disturbances of neuro-arthritics; asthma. Hay fever. Emphysema.
Royat (Puy-de-Dôme) (1475 ft.)	Eugénie: 95.9°	5.623	Sodium: 1.349 Calcium: 1.000 Magnesium: 0.677 Potassium: 0.435	1.728	Lithium chloride: 0.035	Chronic bronchitis. Chronic pulmonary congestion in arthritics; emphysema with cardiac insufficiency of mild grade.
	Saint-Mart: 84.2°	4.474	Sodium: 0.800 Calcium: 0.969 Magnesium: 0.650 Potassium: 0.187	1.565	Do.	

H. Sodium and Magnesium Sulphate Waters.

General Indications: Constipation; congestion of the liver, abdominal stasis, portal hypertension, hemorrhoids in the obese, the constipated, or subjects with intestinal disorder. Obesity.

RESORTS.	SPRINGS AND TEMPERATURES.	$MgSO_4$	Na_2SO_4	$MgCl_2$	OTHER SALTS. (grams per liter).	SPECIAL INDICATIONS.
Brides (Savoie).	95° F.	0.50	1.6	—	—	Obesity.
Châtelguyon (Puy-de-Dôme).	75.2° to 100.4°	—	0.5	1.563	Sodium chloride: 1.633 Calcium bicarb.: 2.176 Sodium bicarb.: 0.955	Mucomembranous enteritis of atonic type.
Miers (Lot).	59°	—	2.675	0.750	—	—
Montmirail (Vaucluse).	Eau Verte: 60.8°	9.31	5.06	0.83	—	—

I. Calcium Sulphate Waters.

GENERAL INDICATIONS: All disorders which might be benefited by pronounced diuresis: Uricemia, established gout, lithiasis and catarrhal affections of urinary tract, cholemia, etc.

RESORTS AND ELEVATIONS.	SPRINGS AND TEMPERATURES.	TOTAL SOLIDS. (grams per liter).	CALCIUM SULPHATE. (grams per liter).	OTHER SALTS. (grams per liter).	SPECIAL INDICATIONS.
Aulus (Ariège) (2625 ft.).	5 springs: 53.6 to 66.2° F.	2.8	H_2SO_4: 1.3 Calcium: 0.73	—	Skin disorders and syphilis.
Bagnères-de-Bigorre (1825 ft.).	37 thermal springs.	2.6	Sulphates: 2.102	—	Mucomembranous enteritis.
Contrexéville (Vosges).	Pavillon: 50°	2.3	1.5	—	—
Evian (Haute-Savoie).	Source Cachat: 52.9°	0.3	—	—	Arteriosclerosis affecting mainly kidneys, interstitial nephritis, etc.
Hamman-Rhira (Algeria) (1695 ft.).	107.6 to 158°	2.5	—	—	Equable climate; average winter temperature: 55.4°.
Martigny (Vosges).	Source Lithinée: 50.8°	—	—	Lithium (bicarb.) 0.03	—
Vittel (Vosges).	Grande Source: 51.8° Source Salée.	1.739 2.922	0.44 1.421	$MgSO_4$: 0.432 $MgSO_4$: 0.821	—

J. Calcium Sulphide Waters.

General Indications and Contraindications: Same as Sodium Sulphide Waters (next group).

RESORTS AND ELEVATIONS.	SPRINGS AND TEMPERATURES.	SULPHIDE CONTENT AS CALCIUM SULPHIDE. (grams per liter).	SALTS.	MODES OF ADMINISTRATION.	SPECIAL INDICATIONS.
Allevard (1525 ft.).	60.8° F.	H_2S: 24.7 c.c.	—	Inhalation of the gases spontaneously liberated.	Laryngitis.
Enghien.	50 to 57.2° Source Deyeux. Source du Lac.	Free H_2S: 0.018 Calcium sulphide: 0.016 Magnesium sulphide: 0.101	—	—	Laryngitis and pharyngitis.
Pierrefonds (Oise).	53.6°	0.156	—	—	
Saint-Honoré (Nièvre).	80.6 to 87.8°	0.032	Arsenical.	—	Pulmonary tuberculosis, even with hemoptysis.

K. Sodium Sulphide Waters.

GENERAL INDICATIONS: Pulmonary tuberculosis of sluggish type, without congestion or hemoptysis; catarrhal affections of the respiratory tract on a lymphatic basis, but non-congestive; skin disorders, syphilis.

GENERAL CONTRAINDICATIONS: Hemoptysis, congestion, high blood-pressure, arteriosclerosis (even when latent), erethism, etc.

RESORTS AND ELEVATIONS.	SPRINGS AND TEMPERATURES.	SULPHIDE CONTENT AS SODIUM SULPHIDE. (grams per liter).	SALTS.	SPECIAL MODES OF ADMINISTRATION.	SPECIAL INDICATIONS.
Amélie-les-Bains (905 ft.).	22 springs: 68 to 141.8° F.	0.025 to 0.039	—	Winter climate very mild.	Winter treatment of pulmonary tuberculosis.
Ax-les-Thermes (2355 ft.).	71.6 to 169.7°	0.02	—	Baths; inhalation in cabinets; massage.	—
Bagnères-de-Bigorre.	Labassère: 55.4°	0.0464	—	—	Residence treatment of pulmonary tuberculosis.
Barèges (4100 ft.).	14 thermal springs: 68 to 113°	average: 0.04	—	Baths at 96.8°.	Sequelæ of traumatism.
Cauterets (3050 ft.).	96.8 to 136.4°	up to 0.023	—	—	—
Challes.	50.9°	0.513	Sodium bicarb.: 1.	—	—

Eaux-Bonnes (2460 ft.).	Source Vieille: 91.4°	0.021	Sodium iodide: 0.007	—	—
Eaux-Chaudes.	75.2 to 96.8°	0.009	—	—	Uterine disorders.
Luchon (Haute-Garonne). (2050 ft.).	48 springs: 71.6 to 150.8°	0.01 to 0.07	—	Sprays, sometimes into Eustachian tube.	—
Saint-Sauveur.	Source des Dames: 93.2°	0.022	—	—	Uterine disorders.
Saint-Gervais (Haute-Savoie). (2295 ft.).	Source du Torrent: 100.4°	0.005	—	—	Eczema, psoriasis.
Uriage (Isère). (1360 ft.).	81°	H_2S: 0.7% by volume.	Sodium chloride: 6 Sodium sulphate: 1.5 Magnesium sulphate: 0.48	Douche with massage.	—
Vernet (Pyrénées-Orientales).	95 to 150.8°	0.018	—	Inhalation of the gases spontaneously liberated.	—

L. Ferruginous and Arsenical Waters.

General Indications: Iron waters: Chlorotic anemias.—Arsenical waters: Diabetes, psoriasis.—Combined iron and arsenic waters: Diabetes in arthritics, chlorotic anemias, depressed states, neurasthenia, tabes dorsalis, etc.

Resorts and Elevations.	Springs and Temperatures.	Iron. (grams per liter).	Free CO_2. (grams per liter).	Arsenic. (grams per liter).
La Bourboule.	Choussy-Perrière.	—	0.05	Sodium arsenate: 0.028
Bussang (Vosges) (2130 ft.).	51.8° F.	Arsenate: 0.00012	1.78	—
Forges-les-Eaux (Seine-Inférieure).	44.6°	Crenate: 0.022 to 0.098	—	—
Lamalou.	Capus: 59°	Bicarbonate: 0.056	374 c.c.	Sodium arsenate: 0.001
Mont-Dore.	—	—	—	Sodium arsenate: 0.0009
Orezza (Corsica).	51.8°	Carbonate: 0.128	2.15	—
Royat.	Saint-Victor: 69.8°	Carbonate: 0.056	1.492	Sodium arsenate: 0.0045
Saint-Nectaire.	Rocher. Cornadore. Romaine. des Dames.	Oxide: 0.0126 " 0.011 " — " 0.0085	— 0.964 — 0.743	— — Arsenic acid: 0.0065 " " 0.0041
Vals.	Saint-Louis-du-Bois.	Sulphate: 0.39	—	Sodium arsenate: 0.0029
Vichy.	—	—	—	Sodium arsenate: 0.002-0.0037

M. Copper Waters: Saint-Christau (Basses-Pyrénées) (985 ft.), 55.4—59° F. Lingual psoriasis, leukoplakia of the mouth.

MINERAL WATERS OF EUROPE (except France).

A. Thermal Waters.

Austria.—Gastein.
Czecho-Slovakia.—Karlsbad, Teplitz.
England.—Bath, Buxton, Matlock.
Germany.—Baden-Baden, Badenweiler, Nauheim, Wiesbaden, Wildbad.
Italy.—Battaglia, Bormio.
Switzerland.—Leuk, Ragatz-Pfäfers.

B. Carbonated Waters.

Czecho-Slovakia.—Giesshübl, Karlsbad, Marienbad.
Germany.—Apollinaris, Neuenahr.
Switzerland.—Fideris.

C. Sulphur Waters.

England and Scotland.—Harrogate, Moffat, Strathpeffer.
Germany.—Aix-la-Chapelle, Nenndorf, Weilbach.
Italy.—Acqui.
Switzerland.—Alvaneu, Baden, Gurnigel, Heustrich, Lenk, Schinznach.

D. Alkaline and Alkaline-saline Waters.

Czecho-Slovakia.—Bilin, Franzensbad, Giesshübl, Karlsbad, Luhatschowitz, Marienbad.

Germany.—Ems, Fachingen, Neuenahr, Obersalzbrünnen, Selters, Wildungen.

Switzerland.—Passugg.

E. Sodium Chloride Waters.

Austria.—Hall, Ischl.

England and Wales.—Ashby-de-la-Zouche, Cheltenham, Droitwich, Harrogate, Leamington, Llandrindod, Llangammarch, Nantwich, Woodhall Spa.

Germany.—Baden-Baden, Homburg, Kissingen, Kreuznach, Nauheim, Pyrmont, Soden, Wiesbaden.

Switzerland.—Bex, Rheinfelden.

F. Bitter or Purgative Waters.

Czecho-Slovakia.—Franzensbad, Karlsbad, Marienbad, Püllna, Seidlitz.
Germany.—Bertrich, Elster, Friedrichshall, Kissingen.

Hungary.—Apenta, Franz-Josefquelle, Hunyadi-János.
Jugo-Slavia.—Rohitsch.
Spain.—Carabaña, Rubinat.
Switzerland.—Birmensdorf, Tarasp.

G. Alkaline-calcareous Waters.

Czecho-Slovakia.—Marienbad.
England.—Bath.
Germany.—Driburg, Lippspringe, Rippoldsau, Wildungen.
Switzerland.—Baden, Leuk, Weissenburg.

H. Iron Waters.

Belgium.—Spa.
Czecho-Slovakia.—Franzensbad, Marienbad.
England.—Harrogate, Tunbridge Wells.
Germany.—Elster, Homburg, Pyrmont, Schwalbach.
Italy.—Levico, Recoaro, Roncegno.
Switzerland.—St. Moritz, Tarasp.

I. Arsenical Waters.

Italy.—Levico, Recoaro, Roncegno.

J. Barium Waters.

Germany.—Kreuznach.
Wales.—Llangammarch.

KINESITHERAPY.

(*Written with the collaboration of* P. Desfosses, M.D.)

Kinesitherapy refers to treatment by motion. It is applied in several ways: 1. Massage. 2. Passive movements. 3. Active movements.

Massage and **passive movements** require the intervention of the physician or medical gymnast, who supplies the necessary energy to make the patient's body go through various movements. **Mechanotherapy** does not constitute a distinct method, but consists simply in substituting machines for the hands of the medical gymnast for the production of the passive and active movements and for the practice of massage. In everyday practice, mechanotherapy can readily be dispensed with.

Active movements may be divided into:

1. *Movements for purposes of functional education or reeducation; these aim in particular at the training of nervous control of muscles.*

2. *Movements in which the muscular contractions are utilized to better the general health of the individual or to improve local conditions.*

In the first group are comprised training exercises in the child, orthopedic exercises, reeducational exercises (motor incoordination, tics, infantile cerebral hemiplegia, Little's disease, infantile paralysis, etc., in children; tabes dorsalis, hemiplegia, etc., in adults).

To the second group of movements the term **myotherapy** has been applied by Heckel.

KINESITHERAPY IN INFANTILE PARALYSIS.

The cardinal feature of the treatment of the anterior poliomyelitis of childhood is muscle reeducation.

For this muscle reeducation to be possible and of maximal efficiency, the affected limb must be placed at rest from the beginning of the disease.

Indeed, if a muscle is weakened by poliomyelitis and its antagonists allowed free action, these antagonistic muscles will exhibit increased tonicity and the paralyzed or merely weakened muscle will allow itself to be stretched and further weakened. This is the manner in which clubfeet and subluxations of the joints are produced as a result of infantile paralysis.

Immobilization.—Therefore, whenever muscular paralysis following a febrile movement is observed in a child, the affected limb must be placed *immediately, without the least delay,* in such a position that the affected muscle shall be completely at rest and shall not be stretched, its antagonists, however, being placed in a state of tension.

Thus, in the case of paralysis of the deltoid, in order to obviate contracture of the pectoralis major which is no longer opposed by an antagonist and which will keep the arm fixed against the thorax, the upper extremity should be placed at a right angle with the chest, with the elbow flexed and the wrist in extension.

In the case of paralysis of the muscles innervated by the external popliteal nerve, the foot should be placed in a posterior splint which

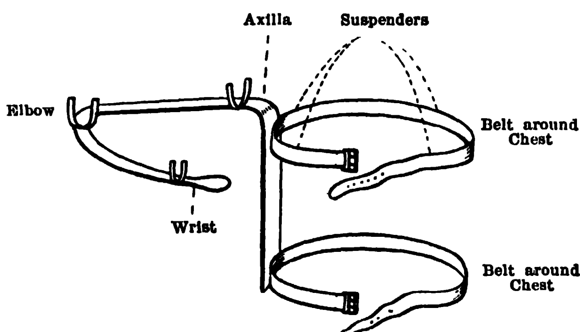


Fig. 24.—Mackenzie's apparatus for immobilization of the arm in paralysis of the deltoid.

will not only keep the foot and leg in good position but also secure extension of the thigh on the pelvis.

This rational posture in which the affected limb is placed must be maintained for a long time, for retrocession of the paralysis may continue for several months; muscles considered lost sometimes eventually regain a portion of their contractility.

Muscle Reeducation.—The fundamental principle which should govern the institution of muscle reeducation in infantile paralysis is that the work imposed on the weakened muscle should at first demand only a minimum of exertion on its part.

One should, therefore:

1. Reduce as much as possible the action of gravity on the limb by placing the origin and insertion of the muscle in the same horizontal plane.

2. Eliminate as much as possible the influence of friction.

3. Place the two segments of the limb in a position such that the efficiency of the force put forth by the muscle is greatest, *i.e.*, in the position in which traction by the muscle is exerted the most effectively on the movable bone.

4. Though the exertion thus demanded of the muscle is the minimum of its normal capacity, it should be remembered that this minimum is really a maximum for the weakened muscle; consequently, the latter should not be called upon to repeat the movement too often.

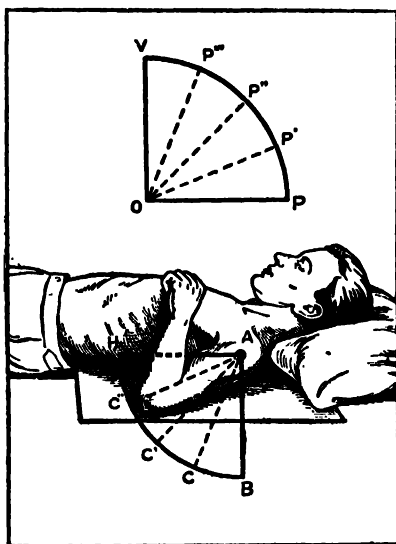


Fig. 25.—Reeducation of the deltoid.

5. In the intervals between séances, neither massage nor electricity should be used; rest in the physiologic position is sufficient.

Reeducation of the Deltoid.—In reeducation of the deltoid muscle, during the stage of immobilization and, in fact, throughout the treatment, the affected limb should be kept in abduction, with the elbow flexed.

The deltoid is essentially an abductor muscle of the arm. It draws the arm up from dependency to a horizontal position. Elevation of the arm above the horizontal, *i.e.*, the second phase of elevation of the arm, does not take place at the shoulder joint, but through a tilting of the scapula brought about by the serratus magnus and the middle portion of the trapezius.

The aim sought in reeducation is to restore to the muscle the power of raising the affected arm from the side of the chest to a right angle, *i.e.*, of causing the elbow to move through the arc, H B.

One should not begin by causing elevation of the arm from H to B, but, placing the arm in the position A C, the patient should be requested to move his elbow from C to B. When he is able to carry out this exercise satisfactorily, the arm should be placed in succession in the positions A C′, then A C″. The desired aim will have been

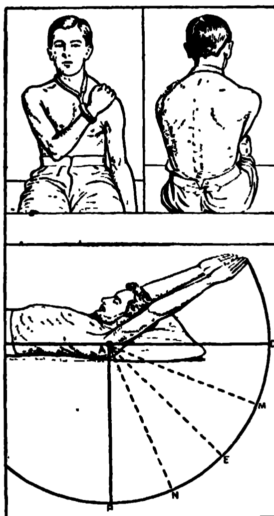


Fig. 26.—Reeducation of the serratus magnus.

attained in this position when the patient is able to carry out with his arm the motion of abduction to a right angle after starting with his elbow alongside the body.

The movement is, of course, harder to execute if the elbow is in extension.

When reeducation of the deltoid in the recumbent position is sufficient, the patient's trunk should gradually be raised, at first in the position O P,′ then O P,″ O P,‴ and finally up to the vertical position, O V.

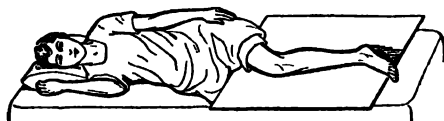
When the action of the deltoid begins to acquire some degree of force and a sufficient amplitude, reeducation of the scapular movement can be begun without waiting for the deltoid to regain all of

its power, reeducation thereafter taking place simultaneously in both areas.

These reeducation exercises should be repeated four times daily for twenty minutes.

The patient can be regarded as cured when he is able to raise the arm from dependency along the side of the body to a position above his head.

Reeducation of the Serratus Magnus.—The function of the serratus magnus is to approximate the scapula to the chest wall and to cause it to describe, in conjunction with the upper part of the trapezius, the tilting movement which permits of elevation of the arm above the horizontal plane.



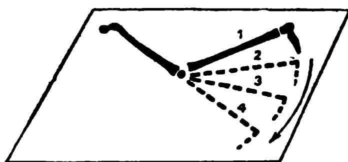


Fig. 27.—Reeducation of the quadriceps femoris in lateral recumbency, with a sheet of cardboard between the thighs.

Paresis of this muscle is manifested by elevation of the shoulder blade of the affected side and its detachment from the thorax; the arm cannot be raised above the head.

As soon as paresis of the serratus magnus is observed, it is necessary to immobilize the scapula in a position that will allow the muscle to be at rest, and prevent its elongation.

In such immobilization, the hand of the paralyzed side should be placed on the opposite shoulder, with the elbow against the chest. A band passing around the neck holds the limb in this position, which places in extension the antagonists of the paralyzed serratus magnus (see Fig. 26).

For purposes of reeducation of the movement of raising the arm, the patient lies on his back, a light cushion under the head; the arm

is placed in the position of the line A M. With the operator supporting the elbow in the palm of his hand, the patient should now voluntarily displace his arm to A D.

Later the work done is increased by having him carry his arm to A E, and then A N.

The desired result is attained when the patient is able to move his arm from B to D.

The training must be carried out very gradually, and the arm not made to go from A E to A D before the movement from A M to A D shall have been secured.

Similarly, A N should not be attempted until the arc E D has been described.

REEDUCATION OF THE QUADRICEPS FEMORIS.—The function of the quadriceps femoris is to extend the leg on the thigh.

In beginning the reeducation of the quadriceps femoris muscle the patient should not be placed in the sitting position, as is too often done, since the movement of extension of the leg on the thigh in this position is possible in the case of a normal or almost normal quadriceps.

The patient should be made to lie on his side, with a sheet of cardboard between his thighs, and should be made to carry out extension of the leg on the thigh, first from 1 to 2, then successively from 1 to 3 and from 1 to 4. When the patient is able completely to extend the leg on the thigh in this position, one may proceed to the execution of the movement in another position, *e.g.*, with the patient lying on his back.

From the above simple illustrations it will be noticed that the procedure in the reeducation of a paralyzed or paretic muscle must be based on muscle physiology; that it requires unlimited patience, and that it is available to the practicing physician, who should see to it that he is assisted and replaced through the day by the mother of the child or some other associate, while himself remaining the arbiter of the increment of treatment to be carried out each day.

MYOTHERAPEUTIC KINESITHERAPY.

Myotherapeutic kinesitherapy relates mainly to the following five purposes:

1. RESPIRATORY REEDUCATION: *Breathing exercises,* as necessary in normal subjects as in the distressing multitude of cases of *respiratory insufficiency.*

2. ABDOMINAL REEDUCATION, an indication almost as common as the preceding and more particularly imperative in visceroptosis, abdominal atony, constipation, obesity, asthenia, and low blood-pressure.

This illustration and the two succeeding ones show the successive stages in nasal reeducation in a little girl.



As will be noticed, n the child without nasal training the alæ nasi are approximated during deep inspira-

Fig. 28.



Fig. 29.—The child has learned to spread the nostrils apart by wrinkling the dorsum of the nose.



Fig. 30.—The child now breathes normally, spreading the nostrils widely apart.

3. CIRCULATORY TRAINING in cardiac insufficiency and neurovascular asthenia.

4. METABOLIC RESTORATION, *i.e.*, a restoration of metabolic balance in the nutritive dystrophies such as plethora, obesity and diabetes.

5. PHYSIOLOGIC MAINTENANCE AND PHYSICAL TRAINING OF THE NORMAL INDIVIDUAL, constituting a true, everyday hygiene of the muscular system.

The fundamental physiologic feature of myotherapy consists essentially in a gradual training of the various systems of organs to the hypernormal degree of function entailed in the execution of analytic or synthetic movements of increasing amplitude and rate.

Myotherapy is thus pre-eminently a "training cure." Like any other kind of training, it requires systematic, careful dosage. No other therapeutic procedure exerts as rapid and profound an effect on the circulation, respiration and nutrition.

This matter of progressive dosage constitutes, indeed, the scientific stock-in-trade of the physical trainer; it is no less indispensable to the myotherapeutist. A precise description of it can hardly be given



Fig. 31.—Diaphragmatic respiration. The abdomen rises during inspiration.



Fig. 32.—Upper thoracic respiration. The abdomen sinks in during inspiration.

here, and an approximate exposition of all its details could not be covered even in a large volume. Practical use and experience are the only good guides in this connection.

I. BREATHING EXERCISES.—Respiratory reeducation consists essentially in teaching a person to breathe in slowly and deeply, to breathe out completely, and in both stages to breathe through the nose.

The chief muscle of respiration is the diaphragm; at the beginning of any course of respiratory training, the individual must be accustomed to use his diaphragm regularly and voluntarily.

The first exercise should be one entailing diaphragmatic respiration in dorsal decubitus. Children who have trouble breathing through the nose generally find this difficulty increased when lying on their backs; it is necessary to restore to them the power to breathe through the nose in this position and to accustom them to use their diaphragm regularly and voluntarily.

Thus, the child should lie down on a table or hard bed. The hands should be placed behind the head in such wise that the fingertips barely come in contact in the nuchal region; the hands should

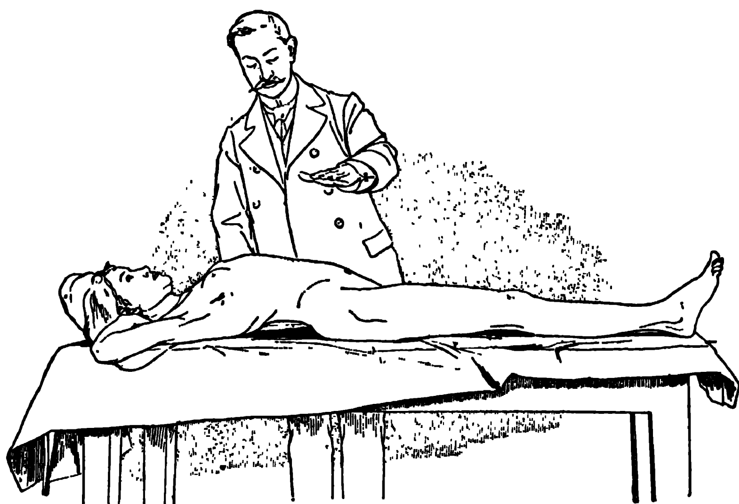


Fig. 33.—Diaphragmatic respiration in dorsal decubitus. First phase: Elevation of the abdomen.

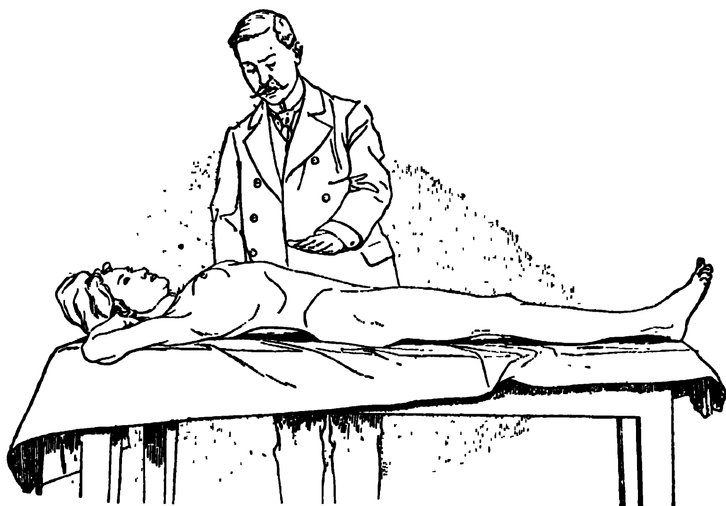


Fig. 34.—Diaphragmatic respiration in dorsal decubitus. Second phase: Expiration; the abdominal wall subsides and flattens out.

be in extension and the elbows resting in the plane of the table; the legs extended, with the heels together and the feet parted at an angle of 45°. The physician, standing by the child, explains and shows him what nasal breathing consists in, then requests him to carry out five or six respirations, with both inspiration and expiration through the nose. The abdominal parietes should rise with each inspiratory expansion of the chest and recede during expiration. The physician should carefully explain to the patient that the abdomen must rise during inspiration and fall during expiration. He regulates the rate

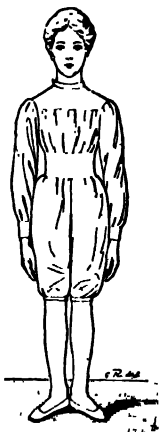


Fig. 35.—Breathing exercise in the military position of "Attention."

of breathing by raising the hand during inspiration and lowering it during expiration; these movements should be rather slow.

After having thus practiced diaphragmatic respiration, the **development of upper thoracic respiration** is next proceeded with. The physician explains to the subject that in upper costal breathing it is not the abdomen but the upper portion of the chest that should rise with each inspiration, while in expiration the chest should flatten. These movements of respiration in the dorsal posture should be carried out from three to five times.

Respiration having been practiced in recumbency, it is then carried out in the standing posture.

Breathing Exercises in the Standing Posture.—Three exercises are particularly to be recommended.

The patient should first be placed in the military position of "Attention."

He stands with the feet at a right angle, the heels together, the knees in extension, the abdomen drawn in, the neck held straight, the head high, the mouth closed, the eyes directed forward and slightly upward, the shoulders held back and effaced, an effort being made to keep the shoulder-blades in close apposition to the thorax, with the arms hanging naturally and the fingers together and extended along the lateral aspect of the thighs.

In this posture, which to be correct, requires considerable exertion on the part of the muscles of the neck, the muscles fixing the scapulæ and the abdominal muscles, the subject should carry out long, even

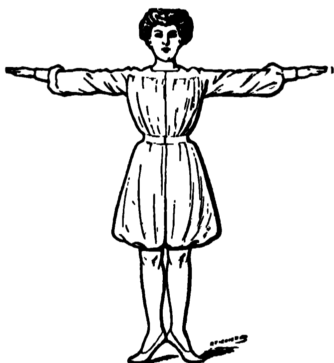
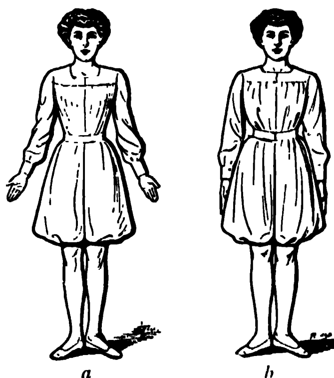


Fig. 36.—Breathing exercise with abduction of the arms and raising of the body on tiptoes.



a *b*

Fig. 37.—Breathing exercise in the standing posture with outward rotation of the upper extremities.—(*a*).

The subject, starting from the position of "Attention" rotates the arms outward, effacing the shoulders and taking a deep inspiration. (*b*) In the second phase, the subject resumes the position of "Attention" while breathing out deeply.

movements of inspiration and of expiration at the rate of sixteen to eighteen a minute.

Breathing Exercise with Abduction of the Arms and Raising of the Body on Tiptoes.—Starting from the position of "Attention," the subject rises on his toes and raises the arms laterally to the level of the shoulders, meanwhile executing a deep inspiration, then descends again onto his heels and lowers the arms while executing a deep expiration.

Breathing Exercise with Outward Rotation of the Arms.—The subject, in the standing posture, rotates his arms outwards, carrying the shoulders back and at the same time breathing in deeply; in

the second step of the exercise, the arms are brought back to the position of "Attention" while breathing out deeply.

These elementary eupneic exercises, which can be varied in an almost indefinite number of ways, constitute the foundation of all kinesitherapeutic training. These or similar movements should always form part of the group, whatever it may be, of exercises, constituting a séance of physical culture. To be complete, the breathing exercises should be combined with exercises of the extremities and trunk, and these will be effectual in proportion as they bring about automatically a species of "air hunger," *viz.*, an imperative need of breathing.

Reading aloud, recitation, singing, dancing, and rhythmic gym-

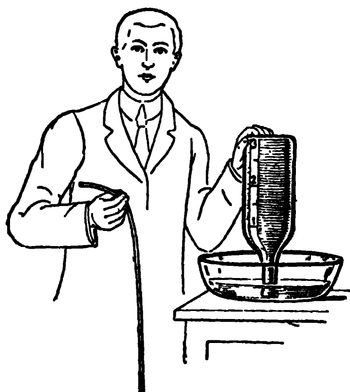


Fig. 38.—The bottle procedure (Pescher). First step: The bottle has been filled with water and the subject is about to pass the rubber tube into it.

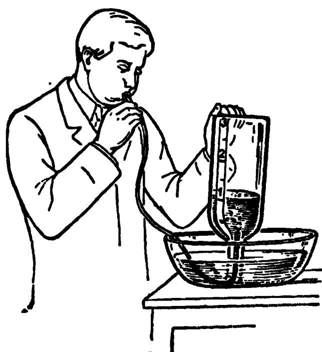


Fig. 39.—The bottle procedure (Pescher). Second step: The patient blows through the rubber tube.

nastics afford synthetic exercises in respiratory gymnastics which, properly regulated, constitute a remarkably effective course of respiratory training.

Many hydrotherapeutic procedures may be combined with them and markedly enhance their action in developing the respiratory function.

On the other hand, there are special morbid conditions, such as asthma, emphysema, adhesions and pleuropulmonary fibroses following pleurisy or pneumonia, which require special procedures.

A good form of exercise to be ordered in such cases is the well known procedure of *artificial respiration.* The physician, standing at the head of the bed on which the patient is lying, raises the arms of the sub-

ject on either side of his head during inspiration and lowers them during expiration.

This "assisted" respiratory exercise may likewise be carried out with the patient seated on a stool or across a low bench; the physician, standing behind him, can raise his arms cross-fashion during inspiration and lower them during expiration; he can also place his hands below the patient's axillæ, raise the shoulders and draw them together during inspiration, and allow them to sag during expiration.

Many different forms of apparatus have been devised to facilitate this species of combined active and passive respiratory exercise.

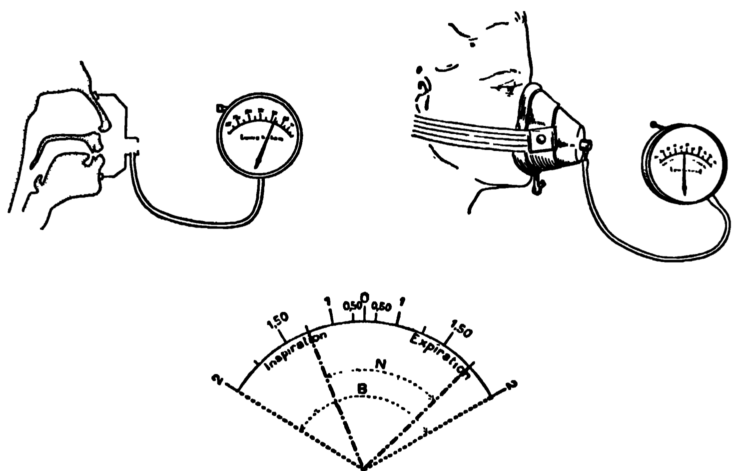


Fig. 40.—Pech mask in use, with an outline in cross section of the nasal fossæ. Below is shown the respiratory output of a man of 52 years. The normal respiratory output by the mouth is 2 liters on inspiration and on expiration; the nasal respiratory output is much reduced on inspiration (1.25 liters), greater on expiration (1.75 liters).

Along another line are the devices of Pescher, calculated to afford patients a means of respiratory training available to all.

The Bottle or Spiroscopic Procedure.—The subject, having carried out slowly a prolonged, continuous inspiration, blows into a receptacle filled with water, thereby driving out the fluid (Figs. 38 and 39).

Use of the Pech Mask.—In order to check up on the respiratory function, as well as for respiratory reeducation, an excellent apparatus is afforded in the Pech mask. This instrument consists of a metallic mask, provided with a pneumatic attachment of rubber, giving an air-tight closure of the patient's respiratory orifices. Under these condi-

tions, the interior of the mask communicates with the outer air only by means of a hole in a thin partition, which hole is of slightly greater section than the corresponding opening in the average respiratory tract.

Accordingly, the breathing of the subject under examination can in no case be impeded. Behind the opening and a little below its lower margin is a tube. To measure the respiratory output, one has merely to connect the tube with a manometer conveniently graduated in liters and fractions of a liter per second.

With this apparatus one is enabled to determine whether the defect in the breathing relates to inspiration or to expiration.[1]

Upon requesting the patient to breathe through the nose into the mask, one notices at once whether his mode of respiration is normal

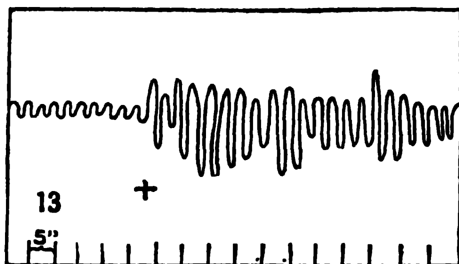


Fig. 41.—Tracing of the respiration taken by means of the Pech mask. The black cross marks the beginning of a muscular effort.

or defective. The patient himself readily becomes aware of these defects, and is able to correct them by employing the mask as a means of training.

Every physician aspiring to direct or control physical education or training for sports or military service owes it to himself to examine with the Pech mask the maximal respiratory output of all those who are to undergo such training. All exercises that are somewhat violent, such as running, jumping, and bicycle riding, should be forbidden to those whose respiratory capacity is insufficient.

II. ARTIFICIAL RESPIRATION.—Aside from its use in the treatment of collapse under anesthesia or the asphyxia of drowning, artificial respiration may be employed as a means of "physiologic massage of the heart" (J. Haedicke), not only after accidents that have caused cranial traumatism or concussion of the brain, but also in heart disorders, notably in the presence of lagging circulation.

The manipulations entailed in artificial respiration stimulate the heart to resume its activity under physiologic conditions. The supply of oxygen thus brought to the heart fortifies it and thereby contributes to the restoration of normal heart-action. At the same time, this physiologic massage facilitates evacuation of the right heart and its filling through immediate aspiration of the blood of the venæ cavæ and of the regions adjoining the thorax.

The various methods of carrying out the mechanical movements of artificial respiration in man are the following:

1. The *Marshall Hall* method consists in placing the subject on the belly, facing forward, and alternately rolling the body onto the side

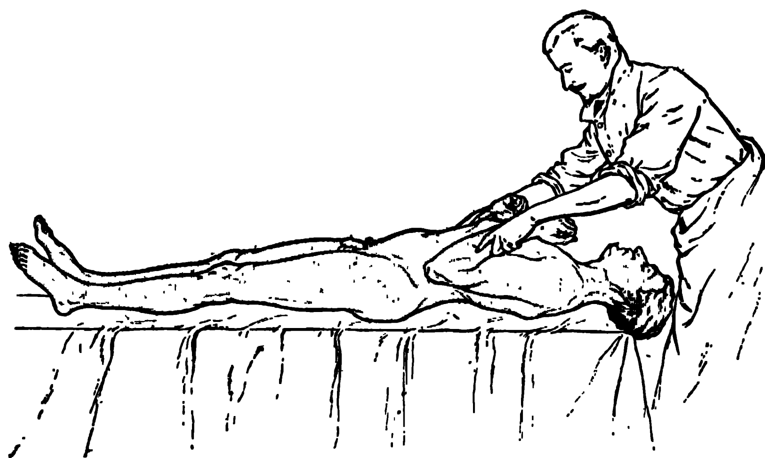


Fig. 42.—Artificial respiration. First step: The surgeon presses the arms against the chest.

and letting it fall back on the abdomen, pressure on the back being made when he is in ventral decubitus.

2. The *Howard* method consists in emptying the thorax by strongly compressing the lower part of the chest; upon releasing the pressure, the chest refills itself with air. The subject is in dorsal decubitus (see Fig. 42).

3. The *Laborde* method, of rhythmic tractions on the tongue, consists in firmly seizing the tongue either with tongue forceps or, failing this, with a handkerchief or other piece of cloth. With the right hand the tongue is drawn out of the mouth, then it is allowed to return of its own accord without letting it go, while at the same time pressure is made with the left hand over the epigastrium. The pres-

sure with the left hand is now discontinued and the traction with the right hand resumed, the same movements being repeated in regular rhythm 15 to 20 times per minute. The Laborde method is not, strictly speaking, a method of artificial respiration since it does not insure the mechanical movements of respiration; it is simply a means of stimulating the lost respiratory reflexes. The method constitutes an excellent accessory to that of Sylvester.

4. *Sylvester's Method.*—In carrying out artificial respiration, the patient is placed with the head low. The operator stands at the end of the table, behind the patient's head, laying hold of the patient's

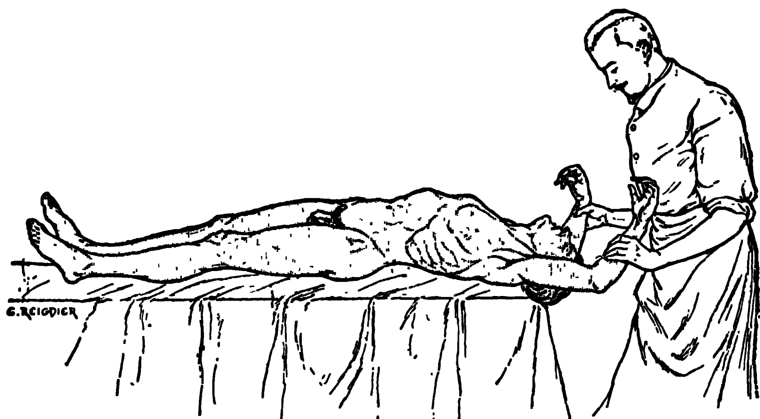


Fig. 43.—Artificial respiration. Second step: The surgeon raises the patient's arms on either side of the head.

arms at the elbows if possible, or of the forearms if the elbow regions are too large to afford a good hold. He carries the arms over the chest, upon which he makes vigorous pressure; next, *without hurry,* but *with vigor and a sweeping movement,* he raised the arms on either side of the head, waits two seconds, and then brings them back onto the sides of the chest, upon which he makes strong pressure. He continues this process slowly, vigorously and deliberately so as to produce about twenty movements of inspiration and of expiration per minute.

The operator cannot be too strongly enjoined to remain cool; here, more than under any other circumstances, hurry and alarm are fraught with risk; the loss of a few seconds or minutes in carrying out precipitate and consequently ineffective movements means certain death to the collapsed patient.

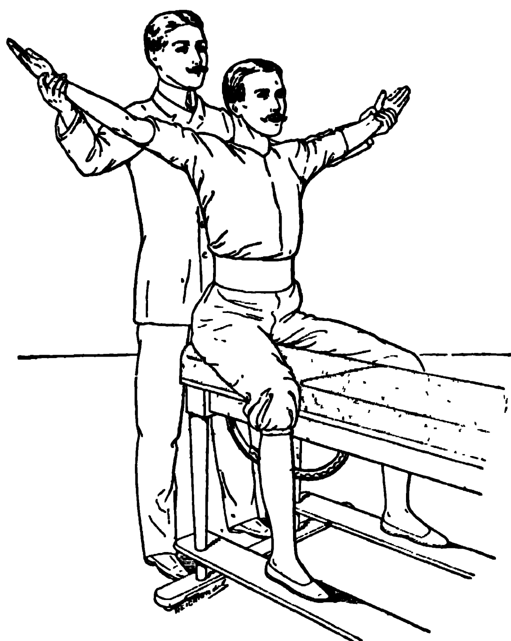


Fig. 44.—Artificial respiration exercise with the patient sitting astride a bench.

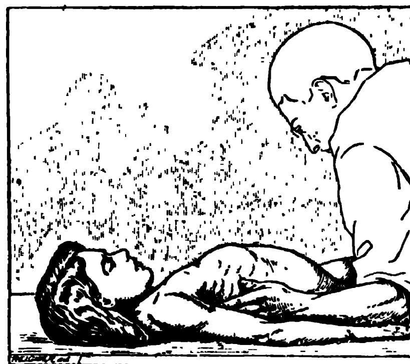


Fig. 45.—To complete the expiration, the physician has placed his hands on opposite sides of the patient's chest and makes pressure on the lower ribs.

Generally, when cyanosis exists, normal respiration will thus be reestablished; the operator should, however, not discontinue the procedure when the first spontaneous respiratory movement appears, but should keep it up until complete restoration of regular breathing has occurred.

When the operator lacks the necessary strength or has an experienced assistant, it is well, when the arms are being brought back toward the chest, to have the assistant make pressure on the sides of the chest with his hands.

Artificial respiration in heart cases need not always necessarily be performed in the recumbent posture; it may with advantage be practised in the sitting position on a stool or astride a bench.

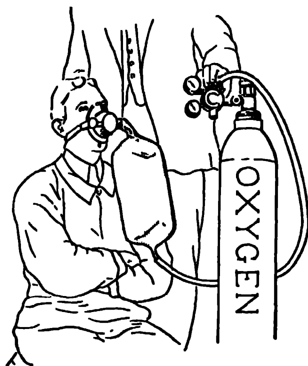


Fig. 46.—Mask of Legendre and Nicloux.

The disadvantage of the foregoing methods is that the asphyxiated subject is in dorsal decubitus; all the muscles are relaxed, and if the head is thrown backward the tongue has a tendency to block the pharynx and obstruct the air-passages. In asphyxia by immersion, for example, the water and mucus, beaten up with the air, form a froth which may block up the bronchial tubes.

5. The *Schaefer* (Edinburgh) method is free of these drawbacks. The subject is placed in ventral decubitus, preferably on the ground, or on some resistant surface; a fairly thick garment or a blanket is placed between the ground and the epigastrium. The operator kneels by the side of the patient, or better, over the patient, with his knees spread apart; he places his hands above the patient's lower ribs, then slowly and gently (especially in the case of a child), he makes pressure on the patient's chest and expels the air from it. After this gradual movement, the operator relaxes the pressure on the chest, while

raising his body but leaving his hands in place; the air is thus drawn into the chest through the release of pressure and the natural elasticity of the chest wall. This maneuver must be repeated at least 12 times per minute; a rate of 12 to 15 times a minute suffices.

In this method it is unnecessary to loosen the clothes and to open the mouth and pull out the tongue. If the patient vomits or expels mucus, these matters will fall to the ground and not into the trachea.

Oxygen Inhalations.—It may be of value to supplement the above maneuvers with the inhalation of air enriched with oxygen. This is absolutely necessary in the cases of syncope caused by carbon monoxide.

The usual procedure consists in placing within or in front of the mouth, or in a nostril, a nozzle connected with a rubber bag full of

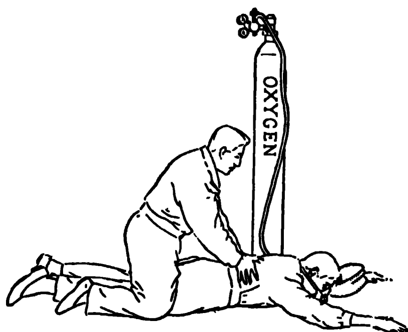


Fig. 47.—Use of the Legendre and Nicloux mask in conjunction with Schaefer's method.

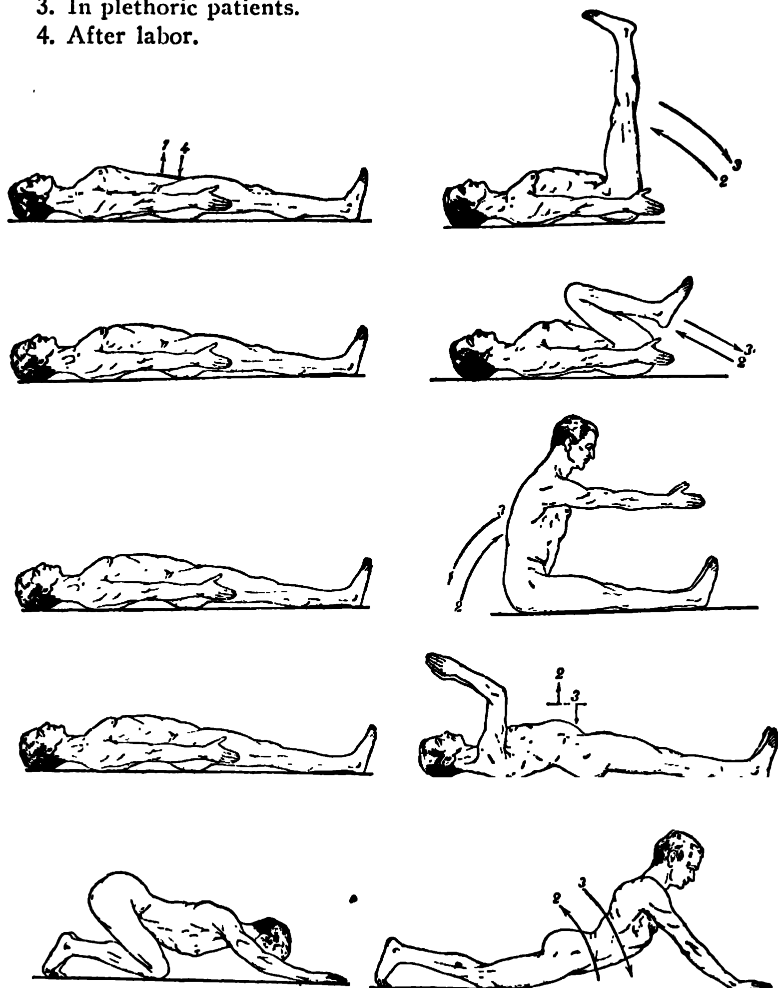
oxygen; this procedure is, however, wholly ineffectual. The method which appears best at the present time is the use of the Legendre and Nicloux mask, which allows the asphyxiated subject to breathe in an atmosphere rich in oxygen. This mask is connected with an oxygen tank by a rubber tube and bag which regulate the flow of oxygen.

III. ABDOMINAL REEDUCATION.—This is of extreme importance, being almost on a par with breathing exercises. Its objects are, in a general way: 1. To restore the muscles of the abdominal wall, particularly the recti, and thus to reproduce or reinforce the weakened or lost abdominal support. 2. To contribute to the training of the diaphragm. 3. To institute an actual powerful process of abdominal automassage which acts very favorably in abdominal atony, stasis and plethora.

It is particularly indicated:

1: In constipation.

2. In atony of the abdominal wall with relaxation of the parietes and abdominal stasis.
3. In plethoric patients.
4. After labor.



Figs. 48 to 57.—Some exercises for strengthening the abdominal muscles.

Five exercises to be carried out systematically morning and evening, slowly and from four to twelve times on an average, are shown in the accompanying illustrations.

IV. CIRCULATORY TRAINING IN CARDIAC AND VASCULAR INSUFFICIENCY.—Myotherapy is an essential part of the treatment of circulatory disorders, of whatever nature. Diet, kinesitherapy and digitalis may alone—aside from specific indications—answer nearly all the indications with which the clinician has to deal in cardiology. One cannot conceive of a plan of treatment applying to a general circulatory disorder which does not specifically involve some myotherapeutic instructions.

The heart and vessels constitute a physiomechanical system with indissoluble mutual relationships. Any reaction of one of the parts of this system inevitably brings about a corresponding reaction of the other. A state of normal circulatory balance always results precisely from harmonious and adequate co-operation of all parts of the system.

Now the muscles form an integral part of it, the left heart representing rather accurately the arterial force-pump; the right heart in conjunction with the lungs representing a species of suction heart, and the muscular system constituting a species of peripheral venous heart.

Nothing affords a better demonstration of the immediate and profound influence exerted on the circulation as a whole by posture and muscular work than the functional tests entailing some exertion. A few elementary observations on pulse frequency, blood-pressure and, if possible, orthoradiography after various exercise tests of varying frequency and nature and in varying postures are sufficient to convince the observer that we possess no agency for treatment of the circulation with an action so prompt, profound, finely graded and subject to accurate dosage as exercise.

The **indications for circulatory myotherapy** present themselves clinically under the three following extremely common circumstances:

Acquired circulatory insufficiency (heart failure or partial cardiac insufficiency).

Constitutional circulatory insufficiency (hyposphyxia).

Peripheral circulatory disturbances, especially relating to the veins (late results of phlebitis).

Acquired Circulatory Insufficiency.

In **heart failure** or **absolute cardiac insufficiency, the indication is** clear and imperative, *viz., absolute rest.*

The heart is completely insufficient for its task. The least exertion requires extra work on the part of the heart. The least exertion, however trifling, increases its insufficiency; there can be no question

of training it to perform more work; its task must be reduced to a minimum, that it may be placed at rest and time gained to bring about cardiosthenic reactions which will save the day.

The directions to be given comprise, therefore:

1. *Absolute rest,* preferably in bed. The sitting posture, instinctively sought by the patient, should be so procured that he is best placed at his ease, without having to make any effort or movement to preserve a "comfortable" state of stability. The legs should be extended and the feet braced, if need be, by some appropriate support to avoid sliding down of the body.

This almost absolute muscular rest should be supplemented by stringent *digestive rest* in the form of a much reduced milk diet, 800 c.c. (27 ounces) of milk being given in four small meals at regular intervals.

Mental and emotional rest is best secured by the co-operation of intelligent and devoted associates, care being taken to exclude as much as possible all sources of annoyance, irritation, worry or anxiety such as would bring on emotional angiospasms—attended with particular risk under these circumstances.

All these measures to promote rest will reduce the work demanded of the heart to a minimum and favor the operation of heart-tonic, diuretic and purgative agents and of various physical measures adapted to the treatment of heart failure, the precise nature of which need not here be recalled.

2. As has been expressly pointed out of late, however, if one wishes the left heart to distribute a sufficient quantity of blood to the different tissues and organs, a corresponding amount must obviously be poured into the right heart. All measures should, therefore, be taken to insure regular filling of the ventricles, and this filling is plainly dependent upon the condition of the venous circulation.

Accordingly, as soon as the patient's general condition and a comparative restoration of regular heart action will permit, *i.e.*, ordinarily about the second, third, or at latest the fourth day of heart weakness, the two following deviations from the absolute rest treatment should be made:

(*a*) Two or three times a day: *Rubs, massage, kneading* and *passive movements of the lower extremities* (complete flexions at the ankles and knees, of the thighs on the pelvis, abductions, adductions, etc.), the patient remaining in the recumbent or sitting posture and strictly passive.

(*b*) *Breathing exercises, practically passive,* in the recumbent or sitting position. The procedure should amount to a short séance of artificial respiration, with the use of the arms, and in which the patient

may participate more or less actively, but without having to put forth any actual effort.

Each sitting should occupy altogether three to eight or at most ten minutes, and include 20 to 40 complete respiratory acts.

No fatigue nor pulse acceleration should result from the procedure, but on the contrary an actual feeling of well-being with improvement of the pulse, at least as far as its amplitude is concerned.

The utility of these measures is obvious. The passive movements of the limbs promote venous depletion and repletion and consequently insure a more copious and regular flow of blood into the heart, whence—the heart having regained a portion of its power at this time—there results a more effective systole. The semi-passive breathing exercise, practised mainly in the recumbent or sitting posture, promotes emptying of the right heart, thus producing an actual aspiration from the venous system the action of which is particularly apparent in the circulation of the abdomen and the lower extremities.

Under this influence, the respiration and circulation are seen to become more regular, the edema to become reduced or disappear, the liver and spleen gradually to return to their normal size, the urinary flow to improve, and in short, the decompensation to be overcome, leaving in its place, whatever may have been the original heart lesion, merely a relative cardiac insufficiency or partial systolic inadequacy of varying degree.

Relative Cardiac Insufficiency.—The heart has now regained a varying proportion of its functional power. Cautious but progressive heart training should follow the period of rest.

1. *The gentle applications of massage and the passive movements should be continued and increased in duration and amplitude,* the hands of the masseur acting like supplementary peripheral hearts. Such a plan of treatment increases the nutrition of the tissues, maintains muscle tone, forestalls capillary stasis, and often causes an edema of moderate degree to retrocede.

Hydrotherapy, and more especially balneotherapy, is a valuable adjuvant in this stage. The method, as it is practised, *e.g.*, at Bagnoles and at Royat, is founded, in general, on the manipulations already described, the stimulation of the skin being obtained with water, acting as a muscle tonic as much by the pressure with which it is applied as in other ways.

2. Already in this period, however, it is well to institute *active myotherapeutic training* by means of systematic exercises.

That these exercises must be regulated with precision; that the earlier sittings must be carried out under close medical supervision

and with observation of the pulse-rate, respiration and especially, of the systolic and diastolic blood-pressures, and that they should under no circumstance be left under the charge of incompetent individuals—which would be highly dangerous in such cases—is obvious; but with these reservations, no therapeutic procedure is more pliable, elastic, or more subject to precise dosage, than exercise, ranging from passive movements and massage to moderate sports (billiards, croquet, bicycle riding, tennis, etc.), passing through the abundantly graded scale of simple active movements, Swedish gymnastics, and the composite exercises, with all the variations afforded by adjustment of frequency and the use of graded resistance.

It is naturally not feasible in this connection to lay out any single plan of rational training which will apply without distinction to all cases. *In the aggregate, however,* and during the period in question, the following general scheme may roughly be followed:

First Stage: Rubs, massage and passive movements of the upper and lower extremities in the horizontal position.

Second Stage: Active movements, such as raising of the legs towards the body, flexion of the thighs on the abdomen, raising of the body toward the legs, with interspersed breathing exercises in the horizontal position.

* * *

As the functional power of the heart becomes gradually restored, and the sittings are lengthened and amplified until, decompensation having disappeared, a relative cardiac insufficiency alone remains, the treatment merges, on the whole, into that of **relative cardiac insufficiency, constitutional cardiac debility,** or **hyposphyxia.**

Can one do more than keep a heart case in a state of compensation and avoid acute heart weakness? Can one increase the reserve power or myocardial resistance of the heart? There is no doubt of it in the majority of cases, but here everything depends on a special factor, clinically very striking, but the intimate nature of which is not yet well known, *viz.,* the latent reserve power of the heart—that which is capable of developing either under the impulsion of compensatory pathophysiologic necessity or as a result of myocardial training cures such as form the subject of the present section. Heredity has endowed each one of us with a heart-muscle possessing, like all other organs, a faculty for development or accretion of varying extent. In some persons, normal, physiologic development or growth almost or quite exhausts this constitutional reserve capacity. In others, it

absorbs only a fraction of it, leaving available and latent a considerable amount of power.

This is a clinically obvious fact. There exist individuals with constitutional cardiac debility, in whom heart training and hyperfunction are almost impossible, and who should and can live only at a slow pace, and will compensate but poorly the least heart disorder, if, indeed, it is not fatal to them. This is the case in many hyposphyxics. Heart training is practically impossible in them. They are always on the verge of cardiac insufficiency. It is only in childhood that one is justified in trying, with great caution, to increase the robustness of the heart in these individuals.

At the other extreme are the constitutionally athletic hearts. A most striking example of this is afforded in the ox-hearts of cardiorenal cases, the enormous hypertrophy of which bears witness to a "colossal" grade of hyperfunction.

Between these two extremes, the cardiac weaklings and athletes, is a naturally graded series of all the other individuals, in whom one may, within a varying margin, call upon this power of hypertrophy or hyperfunction—in short, subject them to a course of myocardiac training with more or less benefit. These considerations apply, as a matter of fact, to all other organs—the liver, kidneys, brain and nervous system in particular.

The components of such a course of training are:

Essentially (this cannot be too strongly emphasized): *Myotherapy.*

Secondarily: *Hydrotherapy.*

As a third resort, and if indicated: *Organotherapy.*

In these cases, myotherapy will consist in subjecting the patient, under very close supervision, to a course of kinesitherapeutic, and consequently progressive cardiotherapeutic, training. Any of the kinesitherapeutic modalities involving active movements, such as Swedish gymnastics, co-ordinated movements, breathing exercises, games and sports, may form part of this prescription and participate in the system of training, *provided it be absolutely methodical and progressive.* It is well to be extremely independent in the matter of choosing myotherapeutic measures, and carefully to take into account in planning them the tastes, habits, occupation, tendencies and disposition of the subject. According to whether the patient is a young man or young girl, running or dancing may be counselled by preference; according to whether he is a city dweller or a countryman, billiards or carpentering; according to whether a child or an old person, some running game or bowling, etc. This is obvious. The "systematic" myotherapeutic prescriptions of the "Swedish" type are apt to be neglected by patients because they

are boresome to most of them. It is well always to spice them with some exercise which is a pleasure to the subject, *e.g.*, a game (tennis) or sport (bicycle riding), rhythmic gymnastics, rhythmic dancing, synthetic movements of an esthetic (dancing) or utilitarian (boxing) type.

In short, the myotherapeutic measures applicable in this stage may be summarized thus:

Third Stage: Active movements against resistance, by means of dumb-bells (1 to 2 kilograms), elastic cords (various exercises) or actual resistance exercises.

Fourth Stage: Progressive co-ordinated movements, consisting of walking on level ground for increasing periods and at increasing speeds; walking on hilly ground; stair climbing, and various sports, up to skipping the rope, the severest of the coördinated movements.

While, however, one should be extremely independent as to the composition of the myotherapeutic séances and endeavor to procure pleasant distraction for the patient during the training periods, **one cannot insist too strongly on the absolute necessity of accurate dosage.** Myotherapy relating to the circulation is an admirable as well as fearsome two-edged sword; more certainly active even than digitalis, it is no less certainly attended with risk; an overdose of exercise can no more be prescribed to a heart case with impunity than an overdose of digitalis. In this connection, the functional exercise tests afford at least two valuable criteria in the process of training:

Any exercise which causes an acceleration of the pulse persisting longer than three minutes after the end of the exercise is excessive and is to be abandoned or reduced.

Any exercise which causes a marked increase of the diastolic blood-pressure and in particular a reduction of the differential or pulse pressure is excessive and should be abandoned or reduced.

A serial study of the results of these functional tests constitutes, with orthoradiography, one of the best criteria of successful myocardial training.

* * *

Discussion of the subject will be limited here to these essential general considerations. An entire volume would not suffice for presentation of all necessary details.

Walks on inclined ground, too little availed of though readily feasible in most cities, are particularly adapted to the accurate dosage which, as has already been said, is absolutely essential in heart training.

Balneotherapy as is practised, for example, at Royat, Bourbon-Lancy and Bagnoles is an especially valuable adjunct in this period of training of the circulation.

This same is true of *cardiac organotherapy,* which has frequently yielded extremely encouraging results, in my experience, in cases of hyposphyxia, constitutional cardiac debility and myocardial insufficiency, especially after infections.

The best plan of practice is, if possible, to direct the patient to some good institute of physical training where the treatment will actually be carried out under effective medical supervision, where the patient will learn at least the A B C of practical myotherapy, and where he will acquire the taste for and habit of physical culture.

Otherwise, a good masseur, suitably trained, may conduct the earlier séances under a relatively close medical supervision; then the patient, submitting to regular examinations, can be given carefully thought-out instructions for physical training, judiciously adapted to the individual and systematically progressive. It will be convenient, for this purpose, to have special sheets recalling the fundamental precepts of general hygiene, the elementary reeducational movements, the various games and sports, and the common hydrotherapeutic measures, which can be quickly and easily adapted by means of changes put down in writing to the needs of the individual case.

V. KINESITHERAPY IN THE TREATMENT OF PHLEBITIS OF THE LOWER EXTREMITIES.—Phlebitis of a lower limb, following an infectious disease, *e.g.,* typhoid fever; phlebitis following a postpartum phlegmasia alba dolens; phlebitis complicating a hysterectomy or any other abdominal operation, etc., always leaves behind it a muscular atrophy and a functional disability usually very persistent. Often it is followed by very tight contractions of tendons and stiffness of the joints. For these disabilities the practitioner, the obstetrician, and the surgeon are responsible when they allow them to set in with the thought that it will later be sufficient merely to direct the patient to a mechano-therapeutic establishment or a watering place.

The old precept "prevention is better than cure" is here à propos; kinesitherapy has a great part to play in forestalling these contractions of the tendons and muscle disabilities. Such kinesitherapy is *entirely within the sphere of the practitioner;* it can be practised only by him or under his immediate supervision, for the physician treating the case can alone decide when it should be resorted to and can alone supervise its execution.

Pathological Features to be Remembered.—The primary lesion of phlebitis is inflammation of the inner coat of the vein. In the zone of inflammation, upon the concave surface of a venous valve, fibrin is precipitated, the venous blood coagulates, and a clot forms. This clot is characterized by its adhesion to the wall of the vein and by its arrangement in stratified layers alternately white (fibrin) and red (red corpuscles). The circulation is impeded and slowed. In consequence of this slowing there is formed, at the free extremity of the primary clot, a secondary clot, which is homogeneous, red, elongated and extending afar. Soon from the inner wall of the vein there develop granulations. New-formed capillaries penetrate the clot, which

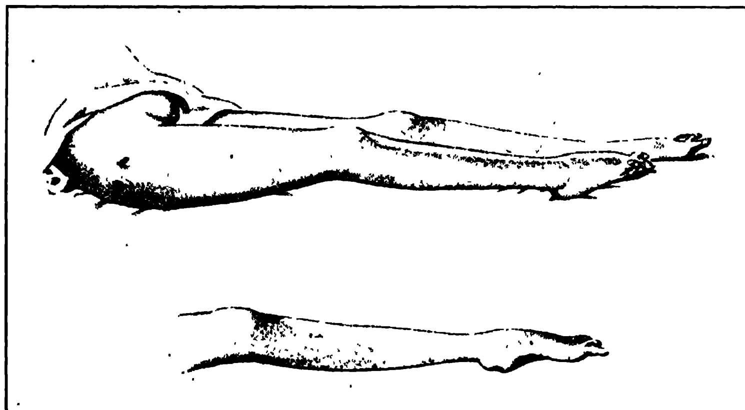


Fig. 58.—Equinus position of both feet with sloughing at the heel, ankylosis of the knees, and ankylosis of both hips in adduction, following a bilateral phlebitis complicating typhoid fever. It is highly discreditable for a physician to allow such deformities to become established.

becomes adherent to the vessel wall; this is termed "organization" of the clot. This organization ends in occlusion of the vein; it is located, in particular, in the primary clot. The secondary clot remains soft for a long time; it may become detached in whole or in part; it will then be carried along by the blood stream and may come to rest in one of the branches of the pulmonary artery, causing pulmonary embolism—so dramatic and so serious, occasionally even causing death in a few moments.

It is the fear of this embolism which holds back the practitioner and too often leads him to prolong inordinately the immobilization of a limb, which he dares not touch and which becomes stiff and disabled.

The course of phlebitis is always accompanied by fever, often but slight. The rectal temperature, which sometimes reaches 39 or 39.5° C.

(102.2 to 103.1° F.), more usually is 37.8, 38, up to 38.5° C. (100, 100.4, up to 101.3° F.).

The treatment of phlebitis by kinesitherapy is in order only after disappearance of the fever.

1st Stage: REST.—The first stage of the treatment of phlebitis is founded upon *absolute and prolonged rest of the affected limb.* The limb should be covered with imbricated compresses soaked in alcohol, covered with a thick layer of cotton, and kept in good position by a wire gutter splint, or better, a Thomas splint (thigh in extension on the pelvis, knee extended, foot at right angles, a small cushion under the knee, and another under the tendo Achillis).

The rectal temperature should be taken morning and evening.

While the dread of embolism calls for prolonged immobilization of a limb affected with phlebitis, consideration for the ultimate good functioning of the part requires that such immobilization should terminate as soon

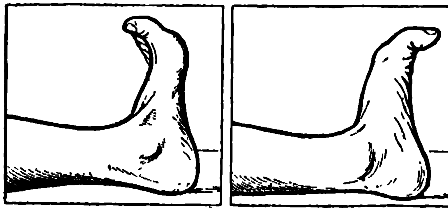


Fig. 59.—Active movements of flexion and extension of the toes.

as possible. The judgment of the practitioner, guided by the temperature, the local condition of the limb, and the general state of the patient, should decide when the proper moment for cessation of the immobility has arrived. The more cautious consider that three or four weeks of complete apyrexia permit of safely starting systematic mobilization. The temperature should nevertheless be watched, and if there is a return of fever, absolute rest of the limb must again be imposed, and the mobilization resumed only after a few days if there is no relapse of the phlebitis.

2d Stage: MOBILIZATION OF THE LIMB IN DORSAL DECUBITUS.—For a test period of about one week, the leg is left in the metallic gutter splint. The upper portion of the compresses is removed. The parts of the limb then accessible without mobilization are now cautiously and carefully, but thoroughly, washed with warm water and soap. This washing exerts a useful effect in reawakening the reflexes originating in the skin.

The washing is to be followed by a very superficial and gentle *effleurage,* sparing the inner aspect of the leg and thigh, and Scarpa's

triangle, and by a *slight mobilization of the toes and metatarsals.* Each toe is seized separately, flexed and extended at each phalangeal joint, and then at the metacarpophalangeal joint. The movements of flexion and extension are repeated for all of the toes taken *en bloc.* The metacarpals are made to play gently over each other.

On the second day the mobilization should still involve the toes and metatarsals, but also extend to the tarsometatarsal joints. The patient should be instructed to carry out a few voluntary movements of flexion and extension of the toes (Fig. 59).

On the third day, the mobilization should extend to the mediotarsal and tibiotarsal joints; it should cause the foot to execute movements of flexion, extension, abduction, adduction, and circumduction.

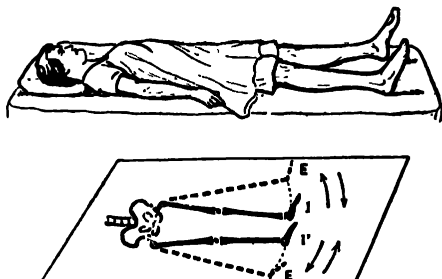


Fig. 60.—Movements of abduction and adduction of the thigh without leaving the plane of the bed.

The patient should himself try to carry out these various movements of the foot without removal of the leg from the gutter-splint.

The sitting is to be concluded by a little *effleurage* of the entire limb, sparing always the course of the large venous trunks.

On the fifth and sixth days, the same movements should be executed, with increasing intensity. Without removal of the splint, the patient is to attempt a few slight movements of flexion of the knee, and a cushion should be placed under the popliteal space in order to modify slightly the position of the femoro-tibial articulation.

Second Week of Mobilization.—The program for the second week comprises an increasingly active mobilization of the foot and more extensive motion of the knee, which brings on automatically movements of the hip. In the course of this week the leg should be removed from the metallic splint, and washed all over with warm water and soap; during the daily séances of mobilization the muscles of the triceps and quadriceps femoris should be subjected to a gentle kneading. The patient should be gradually accustomed to the sitting

position by increasing progressively the number and thickness of the cushions at his back.

3d Stage: PROGRESSIVE MUSCLE TRAINING.—Up to this time, the kinesitherapy has consisted chiefly of passive movements; in the 3d stage, however, it becomes more active. The patient, freed of his splint, enters upon a gradual reeducation of his muscles, while still remaining in bed.

He is allowed to sit up in bed and to be on his side. *Lying on his back,* he is to carry out flexion and extension of the toes and flexion, extension, abduction, and adduction of the foot.

He is to practice abduction and adduction of the thighs while leaving the lower limbs in the plane of the bed. For these movements it will be well to place on the bed a sheet of cardboard covered with talcum powder in order to facilitate slipping about of the two limbs.

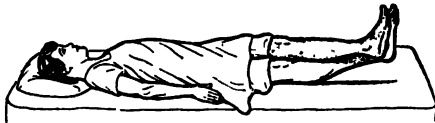


Fig. 61.—Raising the affected lower extremity (shaded) above the plane of the bed. The normal limb assists in the elevation of the affected member.

These movements exercise the abductor and adductor muscles of the thigh (Fig. 60).

Training of the quadriceps femoris calls for special care. The quadriceps must at first be called upon only for a minimum of effort; for this purpose, with the patient lying on the healthy side, a broad piece of cardboard should be slipped between the superimposed thighs and movements of flexion and extension of the leg on the thigh called for. The extremity thus rests in its entire length on a flat surface, and the weakened quadriceps can begin its work with a minimum of effort, not having to contend with gravity.

When the muscle is able to execute these movements easily on the cardboard, one should proceed to exercise the quadriceps with the patient lying on his back; he is thus compelled to raise the extended lower limb above the plane of the bed.

At the beginning, the healthy limb can be used to assist the one affected: The healthy leg, placed beneath the affected one, participates in the raising of the heel above the plane of the bed. The patient can thus grade at will and very accurately the effort to be made by the affected member, according as he dispatches a more or less urgent command to the one or the other of the limbs (Fig. 61).

Another stage will have been reached when the patient is able easily to raise the affected limb without any assistance.

At this time the quadriceps in training may be called upon for a greater effort by requiring it to raise the normal leg. The position of the limbs shown in Fig. 61 should for this purpose be reversed.

To exercise the flexors of the knee at this stage of confinement to bed, the patient may be made to lie flat on his belly (Fig. 62). In this position, the flexion of the knee is performed against the re-

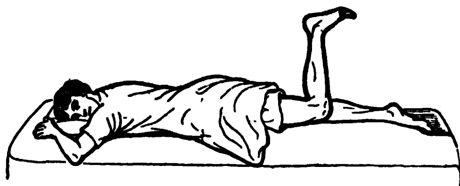


Fig. 62.—Position of ventral decubitus; flexion of the knee.

sistance offered by the weight of the member, to which may be added the weight of the normal leg. In this ventral posture he may attempt to raise the entire leg with the knee extended from the plane of the bed, thus powerfully exercising the gluteus maximus (Fig. 63). Returning to the recumbent position on the healthy side, the patient, by carrying out in this position abduction of the thigh, will exercise intensely the abductor muscles of the thigh (Fig. 64).

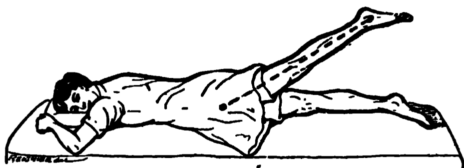


Fig. 63.—Position of ventral decubitus; extension of the lower extremity, held straight.

Movements of flexion of the trunk on the thighs, with the lower limbs remaining on the plane of the bed, will exercise simultaneously the abdominal muscles and mobility of the coxofemoral articulation.

Thus, without leaving his bed, the patient is afforded various different ways of exercising the muscles of his lower limb and of graduating the intensity of the efforts to be made.

These rather fatiguing exercises, which at the beginning markedly affect the pulse, should be interspersed with deep and deliberate breathing exercises, very full inspirations being followed by complete

expirations which give the heart sufficient time to return to its normal rhythm and facilitate the return circulation from the pelvic vessels.

These exercises must be repeated several times during the day—about every two hours. The physician, having prescribed the type, number, and duration of the exercises, should, when visiting the patient, oppose manual resistance to the various movements, in order to learn of the increase of the patient's muscular power.

When he decides that the ankle, knee, and hip have a sufficient range of movement and that the muscles have regained sufficient strength, then and then only may he permit the patient to get up and walk.

It is a grave error of technic to allow a patient convalescing from phlebitis to change abruptly from recumbency to the standing position and to walk without having progressively reeducated the heart, joints and muscles.

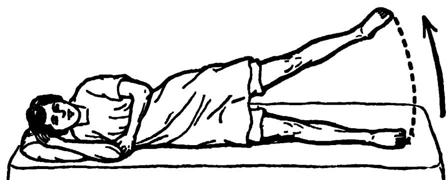


Fig. 64.—Position of lateral decubitus; movement of abduction of the lower extremity, held straight.

4th Stage: GETTING OUT OF BED. SITTING POSTURE. WALKING.—Having reached this period of the treatment the patient will generally request to be allowed to get up. He must not, however, be permitted at once to pass from the stage of recumbency to the standing position. He should accordingly be allowed to sit up once daily, and later several times a day, on the edge of the bed. In this position, with the legs hanging down, he is to exercise the flexor muscles of the foot and the quadriceps femoris by carrying out flexor movements of the foot at right angles and by raising the leg into line with the hip.

The patient, thus properly prepared by progressive daily exercises, will become able to rise and stand on his legs. The first rise to the standing position should not be too abrupt, as a sudden change after a long period in recumbency to the standing position causes vertigo. When he arises for the first time two assistants are generally of use to support the arms and help the body up to an upright position.

Thus supported and encouraged, the patient is to take a few short steps and then return to bed. The second time he is to undertake

a longer walk over to an armchair or Morris chair upon which he may sit for a few moments before returning to bed.

On the succeeding days he should be made to sit on seats placed progressively lower and lower, so as very gradually to increase the flexion of the thigh on the trunk. Each day the duration of the standing position and the walking should be increased. Crutches should under no circumstances be used; they are wholly useless when the patient has been made properly fit for leaving the bed by suitable exercises in the recumbent position.

At first the patient will be anxious on account of the often great edematous swelling of the legs which follows his attempts at stand-

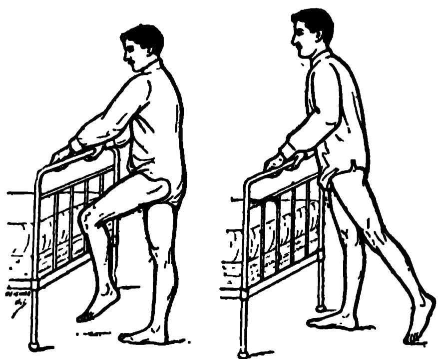


Fig. 65.—Standing posture; exercises of the "marking-time" variety; exercises of extension of the lower extremity, held straight.

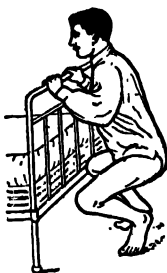


Fig. 66.—Limbering-up exercises with support by the hands.

ing. This edema generally disappears during the night. When it is very pronounced, it will be necessary to alternate the standing and walking with rest periods, during which the affected leg should be kept horizontal or, better, inclined, with the foot held higher than the pelvis, in order that gravity may facilitate the venous circulation.

At this stage of the reeducation for locomotion, the patient, standing and with his hands resting on some object, and with the feet shod with his ordinary shoes or with slippers with heels, should try standing on one foot, first raising the affected limb, which is easy, then raising the sound limb, which is more difficult. In this standing position, with support by the hands, the patient may execute alternate knee flexions with sufficient rapidity to result in a species of marking-time exercise (Fig. 65). In this standing position, with support by the hands, the patient may also train himself in all move-

ments of the thigh on the pelvis, flexion, extension with backward thrust of the foot, and abduction of the thigh, the knee remaining in extension (Fig. 65).

Other very useful exercises are the "limbering-up" exercises with support of the hands: In the first step, the subject rises on tip-toes; in the second, he flexes the hip, the knee, and the metatarso-phalangeal joints of the foot; in the third, he returns to his earlier position (Fig. 66)

Then is to follow walking upstairs, at first step by step, beginning with the sound limb, then ascending in the usual way. Next he is to be trained to go downstairs; the patient will generally prefer to place the affected limb down first, then the sound limb.

If a stationary bicycle can be procured, a course of chamber cycling may be initiated with advantage.

5th Stage: FINAL TRAINING.—The convalescent, having gone through the four previously outlined stages of treatment, will be ready to take up his normal life. He would be well advised to continue to perfect the functioning of his limb by a brisk walk of one hour's duration each morning.

Rowing would be of marked service; bicycling may also be recommended.

If the patient can afford to do so, he may advantageously round out his cure by a stay of several weeks at some watering place (*e.g.*, Aix or Royat, in France), or he may practice swimming in a pool of tepid water.

VI. CORRECTION OF METABOLISM IN NUTRITIVE DISTURBANCES.—This is the field for Heckel's myotherapy.

Indications for Myotherapy.—1. Diabetes, gout, obesity, leanness, rheumatic conditions, asthma and lithiases.

2. Neuroses, neurasthenia, psychasthenia, anxiety, fixed ideas, psychoses.

3. Digestive insufficiency; indigestion (stomach, intestine, liver).

4. Catarrhal conditions of the respiratory and genital mucous membranes; hay fever; nasopharyngitis.

5. Dyscrasic skin disorders (urticaria, eczema, herpes, psoriasis, furunculosis).

6. Endocrin disturbances (exophthalmic goiter, myxedema, functional adrenal or ovarian syndromes, infantilism).

7. Progressive circulatory disorders (arteriosclerosis, phlebosclerosis, varicose veins, anginal syndromes).

8. Arrested development (dystrophies, thoracic inadequacy, rickets, kyphoscoliosis, etc.).

The **progressive myotherapy** to be applied **should include:**

1. *Passive movements of the limbs in dorsal decubitus.* The patient remaining passive, the myotherapeutist carries the limbs through a wide variety of movements.

2. *Active movements in dorsal decubitus:*

(*a*) *Simple, e.g.,* those described in the section on *Abdominal Reeducation.*

(*b*) *Against resistance, mechanical or manual* (Swedish gymnastics).

3. *Active movements in the standing position.*

4. *Progressively graded synthetic movements:*

(*a*) Walking on level ground or climbing; stair climbing; running, on one spot or about a ring; jumping; rope-skipping.

(*b*) Bicycle riding; tennis; swimming; rowing.

(*c*) Fencing; boxing.

VII. PHYSIOLOGIC AND PHYSICAL TRAINING OF THE NORMAL INDIVIDUAL.—Swedish gymnastics is one of the standard methods of physiologic maintenance for the normal subject.

Whenever possible by reason of the proximity of an athletic field or suitable institute, it will often be preferable to substitute for this system Hébert's method, which has led to a complete renovation of gymnastic practices in France. This method consists essentially in procuring physiologic training of the individual by simple and natural means through the execution of useful movements that bring into play in a varied, comprehensive, harmonious and diverting manner the aggregate of organic functions the development of which is being sought. Much less stringent and systematic than the preceding system, and perhaps less amenable to precise dosage, it nevertheless answers much better the ethnic requirements of the Latin races. Furthermore, it is very easy, on occasion, to combine the two systems, and this is, indeed, what Hébert does in interspersing his coördinated exercises with rhythmic movements.

Synthetic Exercises.—Hébert recommends particularly the six useful motor acts—walking, running, lifting, throwing, striking and climbing. Walking, running, the lifting of varying grades of weights, throwing the discus, numerous pugilistic procedures, climbing a rope, pole or tree, etc., are the essential features of Hébert's gymnastic methods. Their rate, succession, intensity, duration and modalities can be varied in an infinite number of ways.

The least discussion of the details would lead us too far afield. The three following remarks will here suffice:

1. This method of gymnastics, taken as a whole, can be availed of only by adolescents and by adults free of heart and lung defects.

2. It can be practised without risk only under rather close medico-physiologic supervision, in the absence of which prejudicial effects and even breakdowns would have to be expected.

3. With these reservations, it probably constitutes one of the best systems of physical training now known.

SPHYGMOMANOMETRIC CONTROL.—The whole foundation of myotherapy lies in the principle of training that will bring into play the reserve power in the organs of the body, particularly the myocardium and lungs, with a view to developing their functions to the utmost.

Its application should be regulated with care, lest, by going beyond the reserve power, the opposite of training, *viz.*, exhaustion, loss of functional balance and reduced reserve power, be the result.

The necessary control should entail systematic observation of the pulse, respiration and blood-pressure, systolic and diastolic. Any exercise or group of exercises which induces for a prolonged period (over three to five minutes) a notable acceleration of the pulse and respiration, or an excessive rise or appreciable reduction of the pulse pressure, should be looked upon as having gone beyond its mark. A pronounced and lasting rise of the diastolic pressure after exercise is to be considered as a particularly unfavorable indication (see *"Clinical Diagnosis:" Functional Tests*).

VIII. EXERCISE FOR THE BEDRIDDEN.*—Rest in bed is a sparing measure.

It is also an antitoxic measure, an antialgic measure, and exerts a soothing influence on the nervous system.

Nevertheless, rest has many serious drawbacks.

Upon rest in bed, liberation of energy in the system is reduced from 10 to 1, and food consumption and oxygen consumption are similarly reduced; consequently, respiration and circulation are slowed down.

Rest means a minimum of food intake.

Rest means a minimum of heat production.

Let rest be continued too long, and the vitality of the individual will diminish, his appetite disappear, the intestinal functions become sluggish, the blood become poorer in oxygen, and the temperature become lower.

The muscles will atrophy from disuse, become flaccid, and at the same time lose their elasticity. Likewise, the joint ligaments become

stiffened, and even the vitality of the bones is impaired. Naturally, too, the lack of muscular activity reacts on the nervous system. The patient condemned to rest feels sad, depressed, held in subjection and lacking in will power.

Like any form of treatment, therefore, rest must be used in proper dosage and not continued too long in all its stringency.

Aside from the help that they may derive from certain procedures of passive kinesitherapy, such as massage and passive movements, patients confined to bed may, in many instances and under careful medical supervision, obtain great benefit from very simple and readily executed exercises.

At the start the procedures may be limited to movements of the arms which the patient is to carry out while lying extended or semi-extended on his back.

Movements of the Upper Extremities.—These movements consist, for the shoulder, in movements of abduction and adduction, rotation of the humerus on its axis, and elevation of the arms over the head; for the elbow, in movements of flexion and extension, and for the wrist, in flexion, extension, lateral tilting outward or inward, and circumduction.

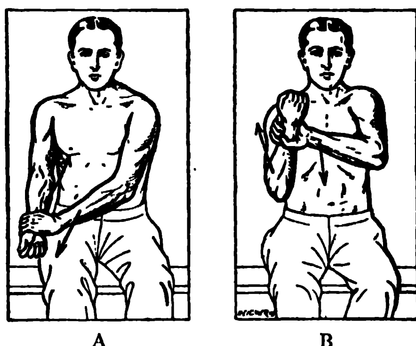
In these various movements, the hand can be weighted with light, ordinary cast-iron dumb-bells or with spring dumb-bells, or even left unweighted; in the latter event, however, it is important for the patient to close his fists and hold them firmly clenched like a boxer about to strike, throughout the duration of the exercise. This contraction of the flexors of the fingers, better insured by the spring dumb-bells, causes the movement to give its maximum yield. Between successive movements the patient should pause, loosen his fingers, and take a deep breath.

It is advisable before beginning the exercises to count the pulse-rate, and take it again after a few movements. There should be no alarm at finding it increased, as this is but natural; if, however, the pulse is found to be irregular or if, after 3 to 5 minutes' rest, normal conditions have not been restored, this means that too many movements have been made without rest or that they have been made too rapidly; the patient should then carry out the procedure more slowly or stop.

When the patient has gotten to the point of executing these arm exercises without fatigue of the heart, he should, while remaining recumbent and with the fists well clenched, aim a few blows at the chin of an imaginary antagonist. These movements of ballistic con-

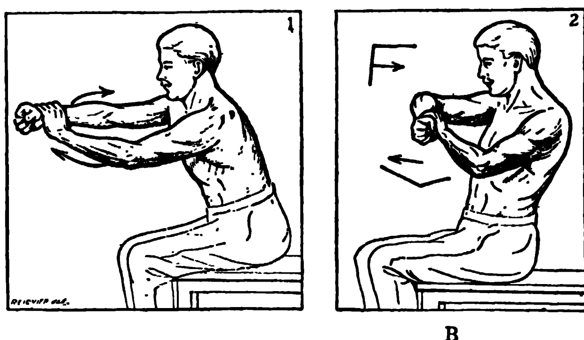
traction, more abrupt than the other movements, will give the patient a feeling as of returning strength and restored energy.

To make the movements more effective and insure their progression, resistance to the active contractions of the arms can be added. With the



A B

Fig. 67.—Flexion of the right forearm against resistance offered by the left upper extremity. The rôle of the two arms is alternated.



B

Fig. 68.—The right arm being extended, it is drawn back toward the chest against the resistance offered by the left arm holding the right wrist.

forearms against the body and the right fist firmly clenched, the right wrist is grasped with the left hand and resistance made to the movement of flexion of the right forearm (Fig. 67).

In another exercise, the right arm being extended in front of the body and the right fist firmly clenched, the wrist is grasped with the left hand and brought back toward the chest against the resistance

offered by the left arm. This exercise is similar to the movement performed in rowing (Fig. 68).

In a third exercise, the left arm, flexed at the elbow and abducted from the body, is brought back in adduction and in front of the chest by the right arm against resistance made by the left arm (Fig. 69).

In this exercise, as in the preceding, the action of the two arms should be reversed at intervals, preferably after each movement.

In these movements, which should be carried out slowly and to their ultimate conclusion, each of the sides of the body plays in reference to the other the rôle of the instructor who, in the Swedish medical exercises, offers resistance to the movements performed by the patient. *These move-*

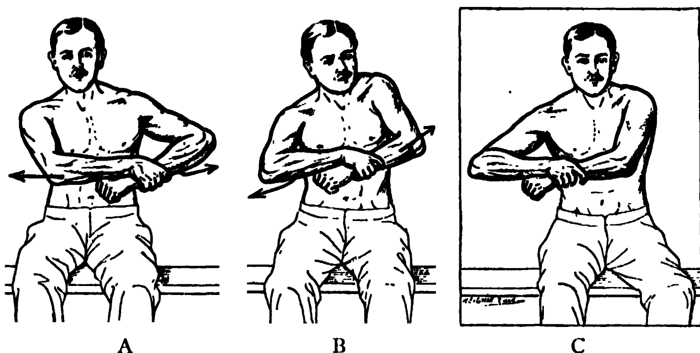


Fig. 69.—The left arm, flexed and abducted, is brought back in adduction and in front of the chest against resistance offered by the right arm. The two arms should be exercised in alternation.

ments require the intervention of the cerebral co-ordinating centers; they constitute exercises for the restoration of will-power.

Movements of the Lower Extremities.—Along with the progressive mobilization of the upper extremities, mobilization of the lower extremities may be begun. The subject should several times daily carry out movements of flexion and extension of the toes; movements of flexion and extension of the feet and of adduction and abduction, and movements of flexion and extension of the knee while keeping the lower limb in external rotation so that the knee, in bending and extending, will not leave the plane of the bed. The subject may also carry out exercises of abduction and approximation of the thighs while leaving the lower limbs on the plane of the bed. To facilitate sliding of the extremity, a large piece of cardboard, over which the lower limbs can rest and move readily, may be placed over the sheet.

The thigh exercises bringing into play large masses of muscle tissue should alternate with deliberate, deep breathing exercises.

The patient can generally try at this period to turn onto his side in the bed, and in this position will be able to carry out much more easily the sweeping movements of flexion and extension at the knee in such a way as to reinforce the power of the quadriceps femoris.

The power of the quadriceps thus gradually restored will permit of attempting, in the dorsal recumbent position, flexion of the thighs on the pelvis, followed by elevation of the extended lower extremities above the plane of the bed, beginning with one leg, next the other, and then both at one time, gradually higher and higher, always keeping note of the mode of reaction of the heart, which must not be overtaxed. When these movements of the lower limb can be carried out without fatigue, exercise of the body by raising the pelvis may be cautiously tried, at first very slightly, with the body resting on the elbows, head and feet, next on the hands, head and feet, and then on the head and feet alone—the whole being done very cautiously and very gradually.

* * *

Having reached this stage, the patient will generally ask of his own accord to get up. He should not be made to pass at once from the recumbency to the standing position. Indeed, static and dynamic conditions relating to the circulation are quite different in the horizontal position from what they are in the standing position. Ordinary observation, within the reach of every one, suffices clearly to demonstrate this fact. The mere change from the horizontal to the standing position increases the heart-rate, even in the normal subject, by about 6 to 8 beats a minute. In a person with a weak heart, or one convalescing from a serious disease, or a case of visceroptosis, this change may reach 12 to 20 beats or more.

More careful observation of the blood-pressures, particularly the arterial pressures, shows, indeed, that with this change in the pulse rate there is coupled a corresponding change in the blood-pressure, almost negligible in a normal subject, but often pronounced in a case of heart weakness or a convalescent or exhausted individual. Cases with marked debility, *e.g.*, individuals in shock, convalescing from severe infections, or with profound anemia, etc., are unable to rise without a fainting spell from the horizontal to the standing position. This change in the pulse rate is readily understood when one reflects on the multiplicity and intensity of muscular contractions required in the standing posture to keep the thighs extended on the legs, the pelvis extended on the thighs, and the chest and head ex-

tended on the pelvis. Intense muscular activity is needed to give the body the rigidity required for the upright posture. Leduc estimates that in passing from recumbency to the standing position, heat production in the system, and consequently power production, is doubled; thus, the heat production, which had been, *e.g.*, 40 to 50 calories per hour in the recumbent position would rise to 100 or 150 calories per hour in the standing position, and increase much more still on walking.

Between the stage of recumbency and that of the erect posture should be introduced a sitting stage in which the object sought should be to complete the re-education and training of the large thigh muscles indispensable for the standing posture.

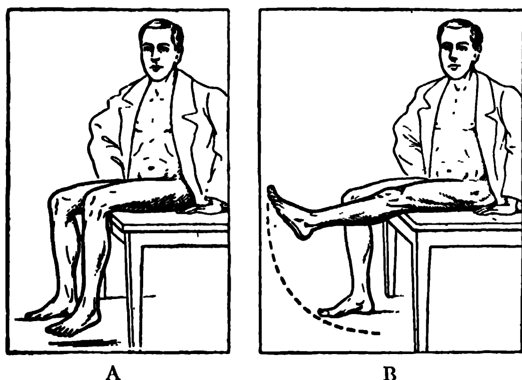


Fig. 70.—Flexion and extension of the knee in the sitting position, with the thigh resting on a firm surface.

To train the quadriceps in this connection the patient, half extended in a low, deep armchair, places beneath his knee the edge of a chair, preferably flat and hard, then raises the leg so as to bring it up in line with the thigh; this exercise requires considerable power and marked exertion on the part of the quadriceps (Fig. 70).

When the patient succeeds in carrying out this exercise several times in succession without fatigue, resistance exercises on the same principles as those applying to the upper extremity should be instituted. The patient should be made to raise one of his legs by the other leg placed under it; the quadriceps muscle will thus be compelled to raise the weight of both legs instead of that of only one (Fig. 71). The patient should further increase this weight by actively contracting the posterior thigh muscles of the leg to be raised, *i.e.*,

by opposing the extensor action of the left quadriceps, *e.g.*, with the resistance of the flexor of the right thigh. A progressive, very vigorous process of training of the quadriceps muscles may thus be secured by alternately reversing the part played by each limb. The same exercise, but with the upper leg brought down to the floor against resistance made by the lower leg kept in extension, will entail active exertion on the part of the posterior muscles of the thigh. With adequate muscular power, the flexors and extensors of the leg on the thigh can thus be brought into action at will.

While the patient is in this sitting position, performance of the various resistance exercises of the arms should not be forgotten. (See Figs. 67, 68 and 69.)

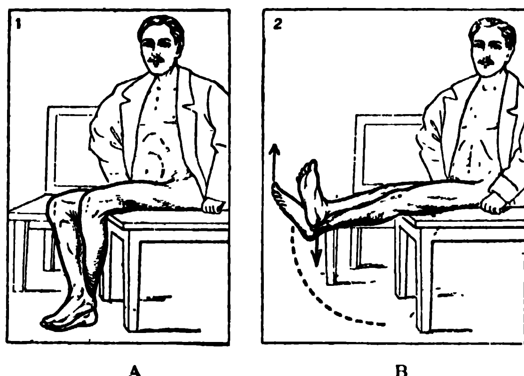


Fig. 71.—In the sitting posture, with the thigh resting flat on a firm surface and one leg resting on the other, the patient extends the left thigh against the resistance of the right leg, or conversely, flexes the right thigh against the resistance of the left quadriceps holding the left leg in extension on the thigh.

By means of the exercises above described and many others that can readily be devised, persons confined to bed can be made to carry out gymnastic movements of great service to them, and can be brought back little by little to the point of restoration of normal function of the muscles and gradually enabled to resume the standing position and walk.

Fifteen minutes of active, regulated and progressively increased muscular contractions will yield much more rapid and profitable results than languid attempts at locomotion with crutches, to which are too often urged patients whose atrophied muscles are incapable of supporting the weight of the body.

ELECTROTHERAPY.

By A. Lomon, M.D.

TECHNIC.

The physician utilizes for therapeutic purposes various **forms of electric energy.**

Those most commonly employed are:

The *constant current.*

The *faradic current.*

The *sinusoidal current.*

The *high frequency currents.*

The *current from the static machine.*

The apparatuses supplying the different forms of electric energy for therapeutic application are very many. Their consideration will here be limited to the most important, and in particular those which the physician without special training may procure and apply himself.

An enumeration of the disorders that are and have been treated by electricity would resemble the table of contents of a text-book on medicine. We shall merely point out those disorders in which electrotherapy is an important feature of the treatment, and particularly those which the non-specialized physician may personally treat with the help of a relatively simple armamentarium.

1. THE CONSTANT OR GALVANIC CURRENT.—Source of the Current.—First Alternative.—The physician has a city lighting current at his disposal. If the current is of the *direct* type, it is availed of directly by means of a wall-plate bearing regulating devices (rheostat or potential-reducer), measuring devices (milliamperemeter, voltmeter), and distributing devices (interrupter, commutator). *This is the ideal solution of the problem.*

If the current supplied is of the *alternating* type, it can be availed of by means of a plate with a small motor-generator.

Second Alternative.—A city lighting current is not being used; the physician employs an accumulator or a battery of electric cells, the latter to consist of 40 cells if all requirements are to be met.

A portable battery made up of small cells may suffice for many procedures. It should consist of 10 to 40 cells, according to the form of treatment to be applied. *This is the simplest solution of the problem.* (Fig. 79, page 492.)

Form of the Current.—When the current is started by closing the circuit, it grows in intensity very rapidly, from zero up to its maximum. This is the *closing period.* The maximum current depends on the electromotive force of the source of current and the resistance in the circuit. Thus:

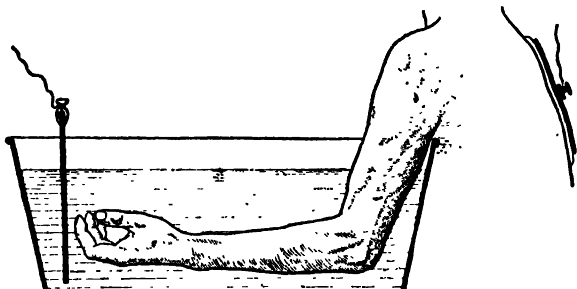


Fig. 72.—Immersion of an extremity.

$$I = \frac{E}{R}$$

where I is the intensity of the current; E, the electromotive force of the source of electricity, and R, the resistance in the circuit.

As long as the circuit is closed, the current remains constant. When the circuit is broken, the current falls to zero. This is the *opening period.*

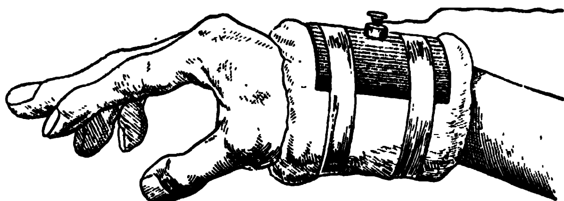


Fig. 73.—Device for the treatment of arthritis.

Application of the Current.—The period of constantly flowing current is that mainly employed in treatment. The opening and closing, if very brief, each produce a muscular contraction. They are used rather in electrodiagnosis than in therapeutics. Their property of exciting contraction of muscle, and in particular of smooth muscle, may be employed sometimes in treatment, *e.g.,* in the electric intestinal douche.

The current enters the system from *electrodes*. These differ markedly according to the purpose for which they are intended: Electrolysis needles; special sounds; tampons of charcoal covered with chamois

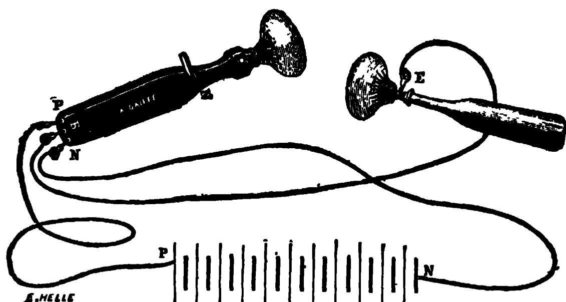


Fig. 74.—Carbon electrodes covered with chamois skin.

skin; sheets of tin of varying size, covered with moistened cotton or felt; immersion of a limb, etc.

It should be borne in mind that the skin is electrically the most resistant tissue in the body; that the resistance in the circuit is great



Fig. 75.—Electrolysis needle.

if the electrode is small; that with equal intensity the density of current beneath the electrode depends on the area of contact, so that whereas 20 milliampères entering from a needle induce necrosis, they cause no harm when entering from a plate 10 centimeters square;

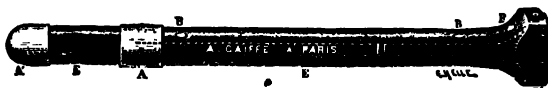


Fig. 76.—Apostoli's bipolar electrode.

and that if there is present an erosion or puncture of the skin in the area of application, all the current will pass in at this point and the density of the current may then cause local injury.

Action of the Current.

At the Area of Contact of the Electrodes.—There is experienced a sensation of pricking and burning which varies in accordance with the intensity of the current. There occurs a capillary vasodilatation, mani-

fested by redness of the skin and a rise of the local temperature. If the quantity of current per unit of surface is great enough, necrosis results. At the *negative* pole, the necrotic area is soft, but slightly retractile, and leaves a soft scar. At the *positive* pole, the eschar is hard and dry.

In the System.—There is produced an increase in the circulation of blood and lymph. Electrolytic introduction of various substances into the system by *ionization* is feasible. The electrodes may be either well-padded plaques or local immersions.

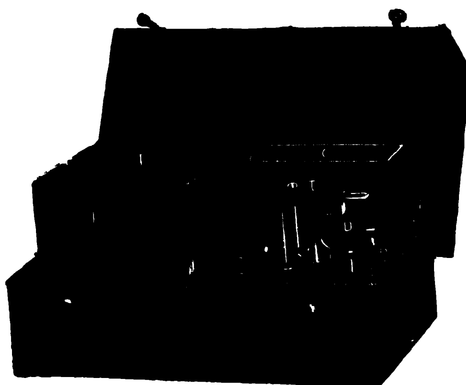


Fig. 77.—Faradic apparatus.

The principal solutions for purposes of ionization are:

Solution	Strength		Pole
Sodium salicylate,	3 per cent.,	at the	negative pole.
Lithium chloride,	2 per cent.,	" "	positive "
Sodium chloride,	2 per cent.,	" "	negative "
Potassium iodide,		" "	" "
Solutions of alkaloids,		" "	positive "
" " quinine,		" "	" "
" " cocaine,		" "	" "
" " aconitine, etc.,			

The alkaloids and metals are placed at the positive pole, and the non-metals and acid radicals at the negative pole.

Sounds of zinc, copper or silver are also employed, principally in urology and in gynecology.

The current intensity used is 1 milliampère per square centimeter of surface.

II. THE FARADIC CURRENT.—Source of the Current.—A weak constant current, such as may be supplied by two battery cells, is transformed into an induced current. The transformation is effected by means of a faradic apparatus consisting of: 1. *A primary or inducing coil,* through

which the primary current flows. 2. A *secondary or induced coil,* made with finer wire. 3. An *interrupter* of the primary current. Provision should be made for regulation of the frequency of interruption. The *tension* of the induced current is regulated either by the choice of the secondary coil, made of wire of varying thinness, or by causing in-



Fig. 78.—Duchenne's electric brush.

duction in a varying portion of the secondary coil. For the latter purpose, the secondary coil is slid over the primary coil for a varying distance.

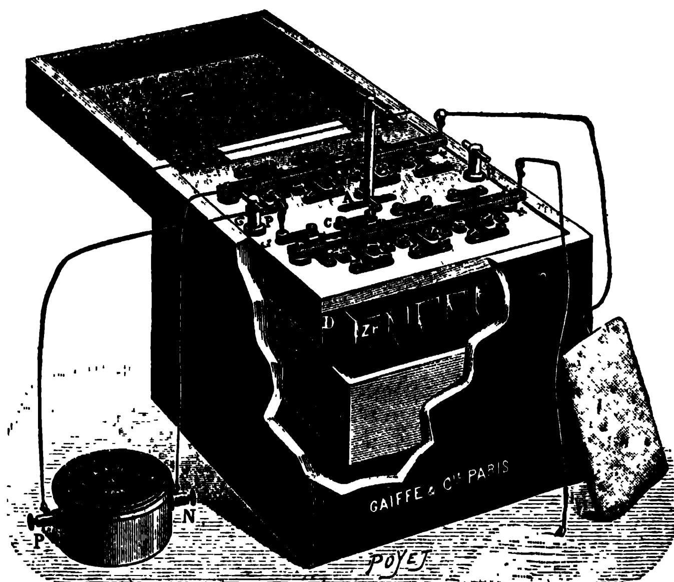


Fig. 79.—A galvanic battery ready for use. At the left of the illustration, *P* and *N* mark the two electrodes of the galvanometer.

Form of the Current.—The induced current exists only during the periods of variation in the primary current which is its source. The following phenomena take place:

1. *The interrupter closes the primary circuit.*—The primary current increase from zero to its maximum. During this period of closing

or "make," which is very brief, the induced current rises from zero to its maximum and drops again to zero. **This is the closing wave.** It courses in a direction opposite to that of the primary current.

2. *The interrupter opens the primary circuit* and the primary current drops back to zero. During this period of opening or "break," the induced current rises from zero to its maximum and drops again to zero. **This is the opening wave.** Its direction is the same as that of the primary current. The electromotive force of the opening wave is greater than that of the closing wave and its duration less.

While the interrupter remains closed there is no induced current.

Application of the Current.—Electrodes similar to those used in the case of the galvanic current are employed. To them is added, however, the metallic "electric brush" (Fig. 78).

The application may be made over an entire segment of a limb by means of very broad electrodes or by immersion of the arm or leg. On the other hand, it can be made at definite points, over muscles or nerves, with electrodes of the tampon type. The two electrodes are of equal activity when their areas are the same. A broad indifferent electrode and a small active electrode render possible a strictly localized action. Counterirritation of the skin is carried out with the electric brush and an indifferent electrode.

Action of the Current.—On the skin there is exerted a sensory effect ranging from a tingling sensation to one of pronounced burning. The vasomotor action results in hyperemia and redness. The action on striped muscles is a contraction at every "break." If the frequency of the interruptions exceeds 20 per second, the muscle goes into a state of tetanus. In the case of the unstriped muscles (stomach, intestine, bladder) there occur contractions which are slower in appearing and relax less promptly.

III. THE SINUSOIDAL CURRENTS.—**Source of the Current.**—The source is the *alternating* current of the city lighting system, with its tension reduced by the interposition of suitable resistance, or, as is preferable, changed into a low-tension current by a transformer for cautery and lighting. In the latter event, the secondary coil made of fine wire is used.

Form of the Current.—It is a periodic current, each period of which is divided into two half-periods which are identical except that the current and direction are reversed.

Application of the Current.—Local: With the same electrodes as are used in galvanization.

General: In an insulating bath. Two broad electrodes are placed, respectively, close to the back and the feet.

Cell-baths, with immersion of two or four extremities, are also used.

Action of the Current.—On *striped* muscle: Action less abrupt and more regular than with the faradic current.

On *smooth* muscle: Strong stimulation of the unstriated muscle fibers.

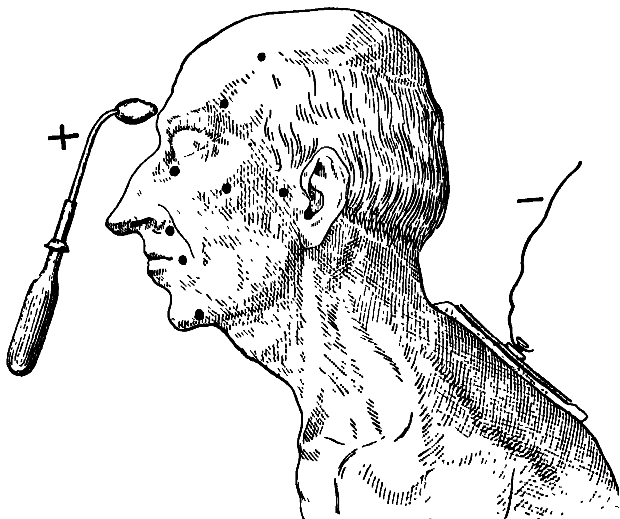


Fig. 80.—Indifferent electrode over the back; active electrode over the forehead.

On the circulation: Activation of the circulation and depletion of congested tissues.

On the nerves: Appears to act especially on the sensory nerves and is used on this basis in some forms of neuralgia.

IV. HIGH FREQUENCY CURRENTS (D'ARSONVALIZATION).—**Source of the Current.**—Use is made of the high-tension current from an X-ray outfit (coil or transformer), which charges the armatures of a pair of condensers. These condensers discharge at the terminals of an adjustable spark-gap. The terminals of the second pair of condensers are connected with solenoids. There are three types of solenoids: 1. Small solenoid of coarse wire for bipolar applications, diathermy and electro-coagulation. 2. Tension-raising solen-

oid, of the type of Oudin's resonator, for monopolar applications, the effluve and spark treatment. 3. Large solenoid for auto-conduction.

There is available an apparatus of very small bulk and readily portable, which is connected with a lamp socket and permits of the application of spark treatment and the effluve.

Form of the Current.—The high-frequency current is an alternating current the direction of which is reversed over 1000 times a second and the oscillations of which are very rapidly deadened.



Fig. 81.—Oudin electrode mounted on a Bisserié handle (glass-sleeved).

Application of the Current.—Local.—*Bipolar method:* This is carried out with the small solenoid and electrodes which may consist either of those used in galvanic treatment or of metal plates, provided sufficient and uniform contact is afforded.

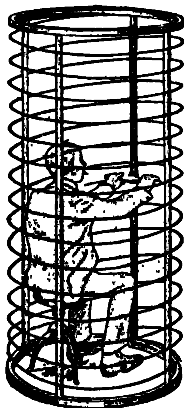


Fig. 82.—Solenoid for general treatments with the high frequency currents.

Monopolar method: Spark treatment or the effluve; carried out with metallic electrodes in the form of brushes, condensing electrodes with glass sleeve (Fig. 81), or vacuum electrodes.

General.—*Auto-conduction:* The patient's entire body is placed in the large solenoid. Induced high-frequency currents are produced within it (Fig. 82).

Auto-condensation: The patient lies on a couch with its upper surface covered with a sheet of metal which constitutes one of the armatures. The other armature is represented by the patient himself who holds in his hands a bar of metal serving as electrode.

Action of the Current.—(*a*) **Bipolar Applications.**—These are made with two electrodes, generally of metal, insuring proper contact with the skin. The effects are analgesic (inhibition of the sensory nerves), vasomotor and decongestive. The diathermic action results in a rise of temperature through the Joule effect, which, when sufficiently intense, may cause a burn and deep necrotic area (*electro-coagulation*).



Fig. 83.—Mode of application of circular electrodes.

(*b*) **Effluve and Spark Discharges.**—These induce fibrillary contractions of the muscles and anemia of the skin, followed by intense congestion. Prolonged sparking causes blistering, next a burn, then destruction of the tissue (*fulguration*).

(*c*) **Auto-conduction and Auto-condensation.**—Reduction of blood-pressure (?) and heightened activity of the respiratory function and of tissue combustion, as shown by an increase of excreted products in the urine.

V. STATIC CURRENTS (FRANKLINIZATION).—Source of the Current.—A static machine with plates.

Form of the Current.—Constant current of high tension.

Applications of the Current.—Static bath: The subject is placed on an insulating stool and connected by a conductor with one of the poles of the machine. The other pole is grounded.

CURRENTS USED IN ELECTROTHERAPY.

Galvanic Current.	Faradic Current.	Sinusoidal Current.	High-Frequency Currents.	Static Machine.
Sources of the Current.				
1. Constant city lighting current. 2. Alternating city lighting current with a rectifier. 3. Accumulator. 4. Battery of cells.	Faradic apparatus consisting of: 1. Two dry cells. 2. One primary coil. 3. Secondary coils of wire of varying fineness. 4. An adjustable interrupter.	A transformer of the *cautery and lighting* type, supplied by the *alternating* city lighting current, the lighting terminals of which are used.	A source of high-tension current (X-ray coil). A pair of condensers. An adjustable spark-gap. Distributing solenoids.	Static machine with plates.
Forms of the Current.				
Permanent condition, the current remaining constant. Period of closure; the current increases from 0 to its maximum. Period of opening; the current drops back to 0.	Opening wave. Closing wave.	Periodic, alternating current.	Oscillations very quickly deadened.	High tension constant current.
Modalities.				
Bipolar. { Plates. Sponge, etc. Baths. **Monopolar.** { Needles. Sounds. **Ionization.** { Drug electrolytes.	Electrodes { Plates. Sponges, etc. Immersion of limbs. Metallic brush for counterirritation.	Electrodes { Plates. Sponges, etc. Local baths.	**Local** { Effluve.—Spark discharge.—Fulguration.—Diathermy.—Electrocoagulation. **General** { Auto-conduction (large solenoid).—Auto-condensation (couch).	Static bath. Static douches. Effluve. Spark discharge.
Physiologic Effects.				
Local. action. { Vasodilatation of skin. Decongestive action. Removal of fibrosis. Necrosis. **General action.** { Acceleration of metabolism. Electrolytic introduction of medicinal ions.	Counterirritation. Strong muscular contractions. Independent twitchings. Physiologic tetanus.	Action on local circulation. Contraction of smooth muscle Contraction of striped muscles.	**Locally.** { Counterirritation. Vasodilatation. Destruction of tissues by electrocoagulation. **General action.** { Lowers blood-pressure (?). Activates tissue combustion.	**Locally.** { Counterirritation. **General action.** { Stimulating to depressed subjects. Sedative in nervous subjects. Improves metabolism.

The effluve, static breeze, static douche, aigrette and spark discharge may well be replaced, it would seem, by similar applications of the high-frequency currents.

Action of the Current.—Locally: The spark discharge and static friction produce the same effects as with high frequency.

General Action: The static breeze and douche are claimed to be sedative and soothing. The static bath exerts a sedative action on the nervous system; it stimulates tissue vitality, improves metabolic processes, and increases respiratory interchanges. There is an increase of the ratio of urea to total nitrogen.

THERAPEUTIC INDICATIONS.

DISEASES OF THE LOCOMOTOR SYSTEM, BONES, JOINTS AND MUSCLES.

Fractures.—Electrotherapy yields very good results in fracture cases, and is not used as often as it should be.

The *constant current* promotes callus formation, activates the circulation in the extremity, antagonizes edema and stasis, and prevents atrophy and joint stiffness. Two large electrodes should be placed at the opposite ends of the limb and a constant current of about 20 milliampères passed through. This treatment is to be applied daily or on alternate days. The use of a portable battery of dry cells, left at the patient's house, is especially to be recommended.

The *faradic current*, by causing muscular contractions, reawakens and promotes muscular tone. It makes the muscles work and in a measure antagonizes atrophy.

The *sinusoidal current* produces the same effects.

It is essential that applications of the faradic current should be made with a coil having a secondary winding of sufficiently thick wire. It is no less essential that the interrupter be of such construction that it can be regulated and can induce spaced muscular contractions. Coils with rapidly vibrating interrupters should be rejected. They tetanize the muscle and fatigue it.

Phlebitis.—A favorable action is exerted on the sequelæ of phlebitis by the same forms of treatment. The galvanic current is used to antagonize edema and impaired nutrition of the limb, and the faradic current to antagonize atrophy.

Sprains and Hydrarthrosis.—The *sinusoidal current* and properly applied *faradic current* promote absorption of effusions in and around the joints, as well as of edema, and reduce the pain.

Painful Flat-foot.—Good effects are obtained by applications of the *faradic current* to the *peronei* muscles on alternate days, using a coil of coarse wire and producing duly spaced contractions.

Abnormally Arched Foot.—Applications of the *faradic current* to the triceps femoris.

Muscular Atrophy of Traumatic or Articular Origin.—The *constant current,* followed by *faradic* stimuli at regular intervals, improves the nutrition of the tissues and affords an excellent form of exercise for the muscles.

In **muscular rheumatism, lumbago** and **torticollis,** *galvanism* with very large electrodes; electrolytic introduction of the salicylic ion; the *high frequency* effluve, or the spark discharge, according to the type of case, reduce pain and contracture.

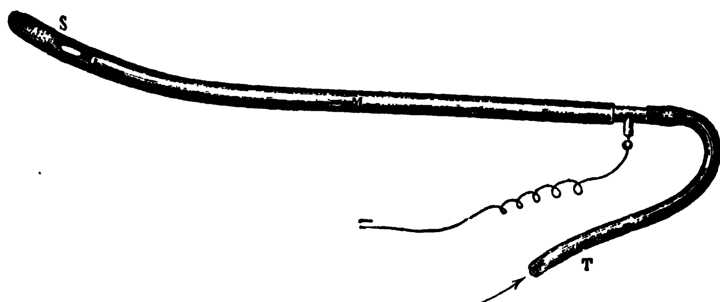


Fig. 89.—Boudet rectal sound.

In **articular rheumatism** and **gonorrheal arthritis,** the *galvanic current* reduces swelling and pain. The measure may and should be applied in the inflammatory stage. The joint can be placed between the two electrodes. The intensity of current should be high (30 to 40 milliampères), and each treatment should be long (1 hour).

DISEASES OF THE DIGESTIVE TRACT.

Paralysis of the Soft Palate.—The *faradic current* is used with a sponge electrode applied in succession to the uvula, pillars and velum. Three to five minutes at a sitting.

If the soft palate is no longer responsive to the faradic stimuli; *galvanism* should be used at the same points with a current of 3 to 5 milliampères.

Spasm of the Esophagus.—1. *Galvanism* of the vagus nerve. Apply two anodes in the space separating the two heads of the sternocleido-mastoid and place a large indifferent plate (negative pole) on the epi-

gastrium. Use a current of 15 to 30 milliampères. Duration: 5 to 15 minutes daily.

2. *Faradism* within the esophagus at the area of spasm by means of a metallic olivary tip mounted on an insulated conductor. The same olive covered with a few layers of moistened gauze will permit of the use of the *constant current:* 5 to 8 milliampères for 10 minutes.

Cicatricial Stenosis of the Esophagus.—Circular *electrolysis* by means of a special rubber bougie bearing a ring of metal; the latter

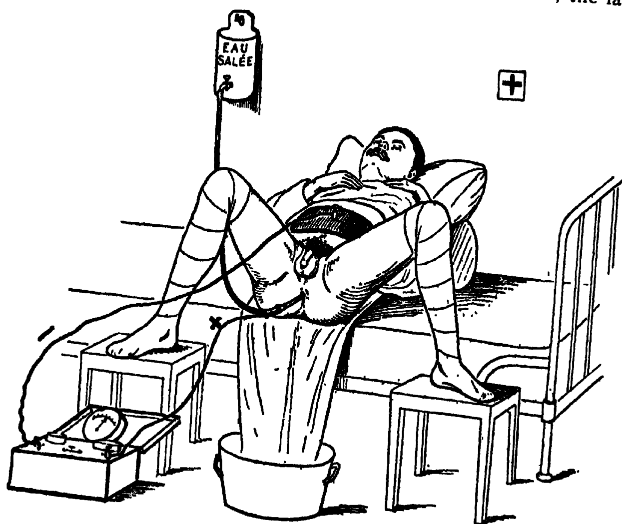


Fig. 90.—The electric intestinal douche.

is carried down to the site of stenosis. A current of 5 to 20 milliampères (negative pole) is used. Weekly treatments with bougies of increasing size should be given. Sometimes application of cocaine to the pharynx proves necessary.

Hyperemesis.—*Galvanism* with a large electrode over the epigastrium and a sponge electrode (positive pole) placed between the two heads of the sternocleidomastoid above the right clavicle. A current of 5 milliampères, with variations up to 20 milliampères, should be used.

Constipation.—The preliminary clinical examination, supplemented, if necessary, by X-ray examination, will give assurance that the constipation is not due to a malformation (angulation or elongation of the colon) or to an unrecognized cancer. Lastly, the differentiation

must be made between ***dyschezia from atony*** in asthenic subjects or those with ptosis, and ***spastic constipation*** (colitis with pain).

In the first instance, the constant current may be used, with two broad electrodes placed over each iliac fossa. The intensity of the current should reach 20 to 30 milliampères. The polarity should be reversed every minute. It appears, however, that faradization is the method of choice. Two electrodes of equal size (10 by 20 centimeters —4 by 8 inches) are placed, the one on the abdomen, the other over the lumbar region. The interrupter is so regulated as to space the contractions.

Each sitting lasts from ten to fifteen minutes. The treatment is given at first daily, then on alternate days.

In spastic constipation with pain, the constant current should alone be used, with the same electrodes as above mentioned and *progressive* increase of strength to a maximum of 50 milliampères. Treatments are given on alternate days.

Intestinal Obstruction.—The Electric Intestinal Douche.—This measure is indicated in beginning intestinal obstruction.

It consists in using saline solution introduced into the large intestine as an electrode to carry the constant current. It is not a treatment for constipation, but an emergency measure.

Technic.—The instrumentation required comprises a battery of cells, a milliampère-meter, an electrode measuring 12 by 18 centimeters (5 by 7 inches), a fountain syringe, a Boudet rectal sound (Fig. 89), two insulated wires, and some boiled, warm saline solution.

The patient is placed across the bed, on a sheet of oil-cloth, with the legs wrapped and protected from exposure (Fig. 90).

An indifferent plate electrode is placed over the abdomen, the sound introduced, and ½ to 1 liter (quart) of salt solution slowly injected. The current is turned on and increased gradually to 40 milliampères, with the sound as the positive pole. After four or five minutes the intensity of the current is gradually reduced to zero and the polarity reversed; the current is then again turned on and gradually increased again to 40 to 50 milliampères.

The duration of the sitting, with reversals of polarity every five minutes, is twenty minutes.

There is now a tendency to abandon the technic which consists in suddenly reversing the current before bringing it back to zero. The contractions thus caused may induce or increase spasm.

The evacuation of feces may occur either at once or in the succeeding hours. If no evacuation has occurred in six to eight hours, another intestinal douche is given, and if required a third in the twenty-

four hours. In this event it is necessary to keep a close watch over the patient and be ready to have the surgeon intervene without loss of time.

It is only if emissions of gas are observed with cessation of the vomiting, meteorism and constant pain, and improvement of the general condition, that one can consider it warranted to continue with this treatment.

The electric intestinal douche acts very well in the obstruction of subjects with chronic constipation and in the aged with an atonic intestine; it is contraindicated, however, in all cases with appendicitis or an inflammatory collection of any sort in the abdomen.

Anal Fissure.—Local applications of *high frequency* effluve act remarkably well on the pain. The spark discharge from the condens-

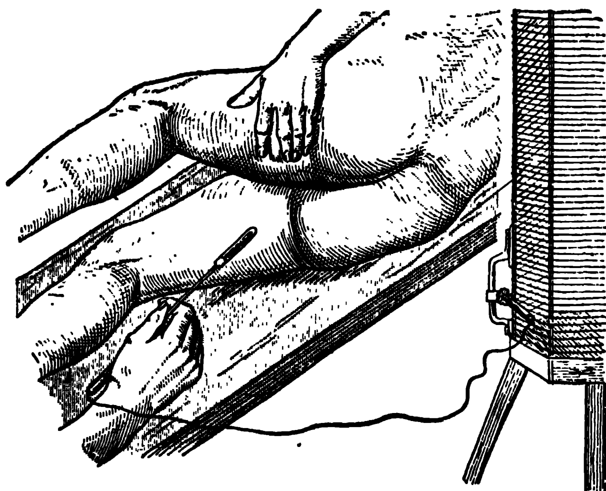


Fig. 91.—Sketch of an intrarectal application of the high frequency current.

ing electrode has an excellent action on the healing of the fissure. The glass-sleeved electrode, which may be covered with a rubber finger-cot, should be used (Fig. 91). The electrode is inserted before the current is turned on. If the electrode cannot be gotten through on account of pain, it should be placed at the margin of the anus and the current applied. The treatment should last from 5 to 10 minutes and be repeated three times a week. Gratifying results are rapidly obtained, as a rule.

Hemorrhoids.—The procedure is the same as for anal fissure, the glass electrode being, however, replaced by a metallic, cone-shaped electrode.

DISEASES OF THE GENITO-URINARY ORGANS.

Incontinence of Urine.—1. *Due to Paralysis or Paresis of the Sphincter.*—Direct *faradization* of the sphincter by means of Guyon's sound, consisting of a flexible, insulated conductor ending in a metallic olive. The sound is passed into the bladder and drawn out until the base of the olive abuts against the sphincter. The frequency should be one interruption in four seconds. A five-minute treatment is to be given daily.

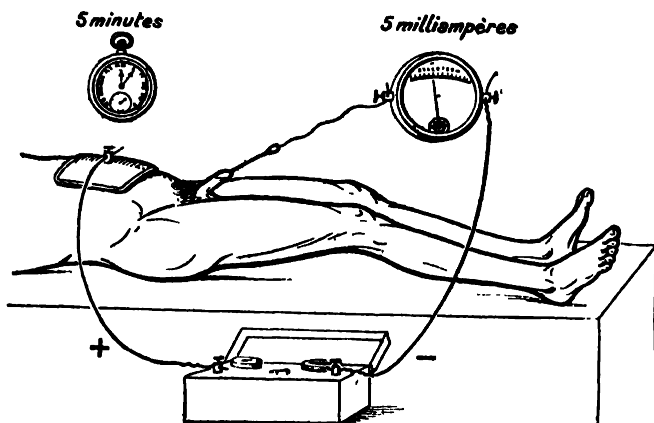


Fig. 92.—Electrolysis of the urethra.

2. *Idiopathic Incontinence in Children.*—Direct faradization is difficult to apply, but external faradization can be carried out with one electrode on the perineum and the other in the lumbar or suprapubic region.

Bladder Paralysis.—Same procedure, but the bladder should be filled with boric solution in order to make it contract on its contents.

Stricture of the Urethra.—Linear electrolysis consists in cutting the stricture by means of a kind of dull-edged urethrotome which is insulated except at its edge. The cutting takes place electrolytically when the intensity of current (negative pole) has reached a certain level. This method has little to recommend it. If the stricture is not a tight one, circular electrolysis is preferable. If it is a tight stricture, infectious complications and recurrence are to be feared.

CIRCULAR ELECTROLYSIS consists in dilating the stricture slowly and gradually by making use of the fibrolytic properties of the galvanic current at the negative pole.

Technic.—Instrumentation: A battery of 10 or 12 cells is sufficient, together with a milliampère-meter, flexible conductors, an indifferent electrode, and special sounds or ordinary prostatic catheters. The patient is recumbent. The prepuce and glans are washed with soap and the urethra and bladder washed out. The indifferent electrode is placed over the abdomen or the thigh. The active electrode may be either: 1. A Bergonié rubber sound, with a central conductor soldered to a metallic ring which forms a slight bulge at the junction of the middle and lower thirds of the sound. 2. An ordinary prostatic catheter. The latter seems preferable, especially in cases of extensive stricture. The catheter is inserted and a current of a few milliampères turned on. If the catheter has not yet passed through the stricture, it will do so within a short time, the alkaline products set free by the electrolysis lubricating the canal and softening the stricture. The catheter is allowed to remain a few minutes. A catheter of the next larger size is then passed. An attempt is made to make a gain of three sizes at the same sitting. The treatment is repeated weekly. It takes considerable time, but is free of drawbacks and gives good results.

Chronic Urethritis.—Electrolytic introduction of silver or copper ions sometimes proves beneficial. Prostatic catheters of silver or copper are used. They are introduced with the usual antiseptic precautions. A current of 10 milliampères is passed (positive pole) for 20 minutes to 1 hour. Nascent oxychloride of silver or of copper is formed and a good detergent action on the affected glands is obtained.

Orchitis.—For the inflammation and the pain, the *galvanic current* is used, with a positive electrode on the testicle and a negative electrode over the spermatic cord in the inguinal fold. The electrodes may be moistened with a 20 per cent. iodide solution. The current intensity should be from 6 to 8 milliampères.

Spermatorrhea.—The *galvanic* and *faradic currents* may be tried, either within the urethra with Guyon's sound; in the rectum over the seminal vesicles, or externally with one electrode in the lumbar region and the other over the perineum.

Impotence.—The *high frequency* spark discharge and effluve should be used over the spinal column at the level of the genital centers in the cord.

Vaginism.—*Faradization* with a coil of fine wire and frequent interruptions and a special bipolar electrode is indicated in this condition.

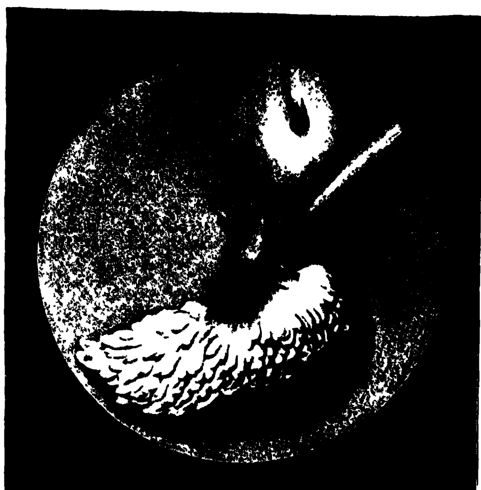


Fig. 93.—The growth has been turned over by the electrode, thus exposing its pedicle, which is to be cut through by the latter.

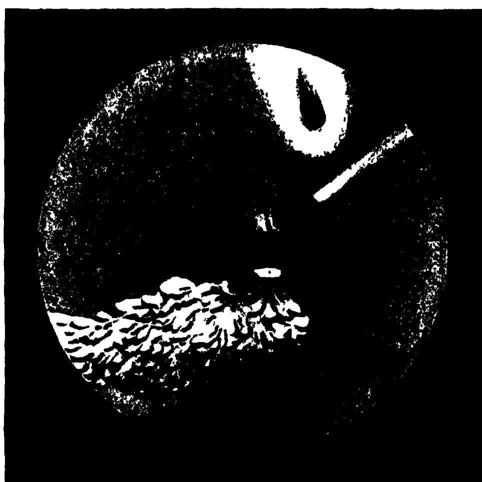


Fig. 94 —The same growth, detached by electric section of its pedicle.

Intra-uterine applications should be reduced to a minimum.

Tumors of the Bladder.—The *high frequency currents* are being used with signal success in the treatment of benign or malignant bladder

tumors. The treatment is applied by means of special electrodes through a catheterizing cystoscope. The growth is destroyed by the spark discharge in a liquid medium (Figs. 93 and 94) or by electro-coagulation. The spark method permits of the destruction of small tumors. If the tumor is large, it can be removed surgically and the spark discharge used for destruction of the stump. Electro-coagulation by diathermy permits of destroying the tumor by application at several points in the tumor. But here again, if the tumor is too bulky, it should be removed by morcellation and electro-coagulation practised at its point of implantation. Hemostasis is perfect with this procedure.

METABOLIC DISEASES.

Gout.—*Local Treatment.*—Lithium is caused to enter the tissues by electrolysis. A 2 per cent. solution of lithium chloride with 0.5 per cent. of lithium hydroxide (positive pole) is used in an immersion electrode, or, if such be not available, applied on very spongy electrodes. A strong current—50 to 150 milliampères—is required.

General Treatment.—Hydro-electric bath with the sinusoidal current. High frequency by auto-conduction or auto-condensation.

Obesity.—Hydro-electric bath with the *sinusoidal* or *galvanic current* and a current of 100 to 150 milliampères.

Faradization of the entire body by the Bergonié method. The patient reclines, without clothing, on a special armchair with its seat, back and arms made of metal and forming electrodes. Large electrodes also cover the abdomen, thighs and arms. The body is loaded with sandbags and the different groups of muscles made to contract, with the intensity of current regulated for each.

Diabetes Mellitus.—Static bath or high frequency by auto-conduction. Ten to thirty-minute treatments on alternate days.

Rickets.—Hydro-electric bath with the sinusoidal current. Galvanization of the limbs with a current of 5 to 15 milliampères.

SKIN DISORDERS.

Almost the only two forms of electricity employed in the treatment of skin disorders are the galvanic current and high frequency, the former being used for electrolysis by means of special needles and the latter in the form of the effluve or the spark discharge.

The following conditions are treated with the galvanic current and by electrolysis:

Hypertrichosis.—Electrolysis destroys the papilla of the hair-follicle and regrowth of the hair is prevented. This is the procedure

of choice when the hairs to be destroyed are coarse and few in number. If the hypertrichosis is extensive, the following considerations should be taken into account before undertaking the treatment: 1. The duration of the treatment; one can hardly remove more than 50 hairs at a sitting and in the case of about one hair out of every ten the electrolysis proves a failure and the hair grows again. 2. The fact that destruction of the hairs in an area activates development of the down in the same area and its transformation into mature hair. Electrolysis should accordingly be reserved for isolated hairs and tufts of coarse hairs. It is the treatment of choice for trichiasis; in this condition, local anesthesia with cocaine is required.

Technic.—A special very fine needle of iridioplatinum, mounted on a flexible conductor connected with the negative pole, is used. The

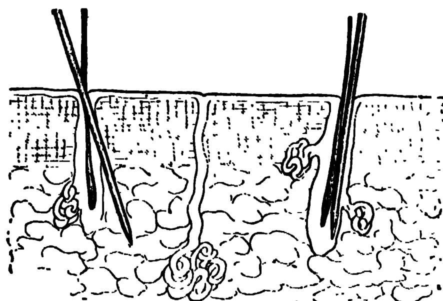


Fig. 95.

Faulty introduction of the needle. Proper introduction of the needle into the hair-follicle.

positive pole is connected with the indifferent electrode, which may consist of a metallic handle to be held tightly in the patient's hand. The needle enters the hair follicle by passing along the hair. If it is inserted in the proper direction, it enters easily and painlessly (Fig. 95). A slight feeling of resistance gives notice to the operator that the bottom of the follicle (at a depth of 2 to 5 millimeters) has been reached. The needle being in place, the current is turned on and increased to 2 or 3 milliampères. In a few seconds, a little white foam appears at the root of the hair. The needle is then withdrawn, when the hair will often come out with the needle. If not, it is picked out with forceps. It should come out without traction. At the end of the sitting camphor in alcohol is rubbed over the area treated.

Trichiasis.—The same procedure is carried out for the hair-follicles at the lid margin. Local anesthesia with cocaine should be used.

INDICATIONS FOR ELECTROTHERAPY IN DISEASES OF THE NERVOUS SYSTEM.

Diseases of the Brain, Medulla and Spinal Cord.

Hemiplegia.

Treatment to be used only in the absence of contracture.

Galvanism: Over the brain.—One electrode at the back of the neck; the other over the affected hemisphere. 5 to 8 ma. for 5 to 10 minutes; all abrupt changes or interruptions in the current to be avoided.

Over the muscles.—Over the paralyzed muscles, to improve their nutrition. 10 to 15 ma. for 10 minutes.

Faradism: Over the muscles.—If there is no contracture and galvanism has been well-borne, muscular contractions should be induced by rhythmic faradic stimuli.

Infantile spinal paralysis.

Galvanism: Indifferent electrode at the root of the member; active electrode over the region of the muscles to be treated. 5 to 10 ma. for 5 minutes over each group of muscles.

Faradism: If the muscle retains its power to contract on faradic stimulation, treatments with rhythmic faradism should be given.—Avoid electric stimulation of normal muscles. Prolonged treatment in series of 15 days with intervening rest periods.

Myelitis.

Traumatic. Galvanism or galvanofaradism if the latter is well-borne. One plate electrode over the affected region of the cord, the other over the paralyzed muscle group.

Syringomyelia and Multiple Sclerosis. Galvanism with one plate electrode in the cervical and the other in the lumbar region. 20 ma. for 10 minutes on alternate days.

Diseases of the Peripheral Nerves.



Device for electric treatment of trifacial neuralgia.

Neuralgias, especially of the

Trifacial. *Galvanic current:* A large indifferent electrode and a *positive* active electrode cut out so as to cover the side of the face except the eye and lips. Current of 40 ma. for 20 minutes. Daily sittings at the start.

Ionization: Moisten the active electrode with 2 per cent. salicylic acid solution and connect it with the *positive* pole. Current of 20 ma. for 20 minutes to 1 hour.

Sciatic. *Galvanic current:* A large electrode beneath the buttock, the other over the calf (or as a leg bath). 30 to 50 ma.

High frequency: Effluve or spark discharge for counterirritation; diathermy.

INDICATIONS FOR ELECTROTHERAPY IN DISEASES OF THE NERVOUS SYSTEM.

Paralysis, especially:
- Facial.
- Multiple neuritis
  - Due to lead.
  - Diphtheritic.

For neuritis: Galvanic current, with same procedure as for neuralgias.

To antagonize paralysis and atrophy, interrupted galvanic current, or faradism. Discontinue all electric treatment in the event of contracture.

Occupational spasms or contractures.
- Galvanism.
- High frequency effluve.

Neuroses.

Sydenham's chorea.
Myoclonus.
Tics.
Functional spasms.
Cramps.

- Static bath.
- Static douche.
- Galvanism from back of neck to feet.

Exophthalmic goiter. Galvanization with one electrode at the back of the neck and the other over the thyroid gland. 25 ma. for 20 minutes. Conclude treatment with faradization of the carotid sympathetic plexus, the superior cervical ganglion and the precordial region.



Device for electric treatment of exophthalmic goiter (applications directly over the goiter).

Anesthesias
Hyperesthesias
Paralyses
Contractures

due to psychoneurosis.

- Galvanism.
- Faradism and local high frequency treatments.

Neurasthenia.
- Static bath.
- Spark discharge over the spinal column.
- D'Arsonvalization.

NOTE: As a general rule, in diseases of the nervous system the *galvanic current* is used to act on tissue nutrition, trophic disturbances, atrophy, edema, etc., and the *faradic current* to induce activity of the paralyzed muscles.

But faradization should be employed only: 1. If there is no reaction of degeneration and, consequently, if the muscle responds to the faradic current. 2. If contracture is absent.

Warts.—The electrolysis needle (negative pole) is passed through the pedicle of the wart; a current of 6 milliampères is allowed to flow for two to four minutes. The wart turns white, and in succeeding days dries up and falls off. If the wart is sessile, its base should be transfixed with several needles.

Acne.—Same technic as in hypertrichosis. The needle is inserted into each sebaceous follicle.

Angiomas.—A negative platinum needle is introduced into the center of the angioma, and a ring of positive needles inserted at its periphery. A current of 10 to 30 or 40 milliampères is used, according to the number of needles. Cicatricial tissue forms at the points of insertion of the positive needles, with resulting occlusion of the blood-vessels. The negative needle destroys the tissue of the angi-

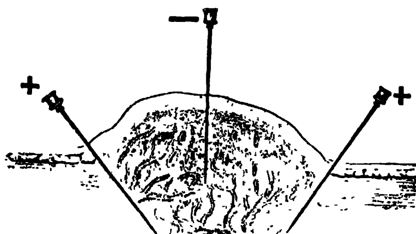


Fig. 98.—The needles at the periphery are introduced obliquely through the tissues.

oma by causing a small area of necrosis. The treatment requires some patience, but gives very good cosmetic results.

Acne Rosacea and Telangiectasis.—The vessels should be obliquely transfixed in order to close their lumina.

Keloids.—The needle is inserted into the tissue of the keloid in a direction parallel to the skin surface. A current of 5 to 8 milliampères is run through for 30 seconds. A series of parallel insertions is made. The treatment should be repeated every week or ten days.

The following are treated by high frequency and static currents:

Itching skin disorders, including local pruritus, anal, scrotal or vulvar. Good results are obtained with the high frequency effluve.

Eczema, Psoriasis, and Alopecia.—High frequency effluves, or the spark discharge with the glass-sleeve condensing electrode.

Lupus Vulgaris and Erythematosus.—The glass sleeve of the condensing electrode should be moved about over the area so as to cause a burst of sparks for two or three minutes. The treatment is repeated twice a week.

RADIUM THERAPY.

By Simone Laborde, M.D.

GENERAL CONSIDERATIONS.

RADIOACTIVE BODIES.

Radioactive bodies occur as simple substances which constitute an independent and *spontaneous* source of energy.

This energy is manifested in a special form of radiation capable of penetrating all bodies, and which is known under the name *Becquerel radiation.*

In medicine, radium, mesothorium, radium emanation, and thorium-X are employed.

RADIATION OF RADIOACTIVE BODIES.

Radioactive bodies emit three types of radiations, known as the alpha, beta and gamma rays.

These rays are propagated in the air and *in vacuo.*

They may be compared to those obtained by an electric discharge in an X-ray tube.

Alpha Rays.—The alpha rays are constituted of positively charged atoms of helium. They have only a very weak penetrating power. The least obstacle arrests them completely, *e.g.,* 0.05 millimeter of aluminum. This means that they are not being utilized when radium is employed in closed containers such as glass or metal tubes.

Beta Rays.—Analogous to cathode rays, these are formed of negatively charged particles projected with a speed close to that of light itself.

They represent only 3.2 per cent. of the total energy of radium.

Conventionally and for convenience in medical parlance, the beta rays are divided into the *soft beta* rays, completely arrested by 2 millimeters of aluminum, and the *hard beta* rays, which are stopped only by 7 to 8 millimeters of aluminum.

The platinum-walled tubes used in medicine completely suppress them. Only enamelled apparatus or glass ampules permit of employing beta radiation.

Gamma Rays.—The gamma rays represent only 4.8 per cent. of the total energy of radium.

They are analogous to the Roentgen rays. Like these latter, they are of a wave-like character, but they possess a considerable penetrating power, which enables them to go through 30 centimeters (12 inches) of lead.

They may be divided into *hard gamma* and *soft gamma* rays.

The absorption of the beta and gamma rays is approximately in proportion to the specific gravity of the absorbing material.

Secondary Rays.—When metals of high specific gravity, and in general elements of high atomic weight, are penetrated by radiation, they cause the production of *secondary rays* emitted by the matter penetrated under the influence of the rays that have impinged upon it. Having only feeble penetrating power, these rays, which in large dosage are injurious to healthy tissues, are easily arrested by substances of low specific gravity.

RADIUM.

Metallic radium is a metal which cannot be kept in the air without impairment. In medicine the **salts of radium** are employed.

In all its combinations radium enjoys the same properties which are essentially bound up with the atom Ra.

The relative quantities of elemental radium contained in these various salts differ materially. Thus, crystallized radium bromide ($RaBr_2$, $2H_2O$) contains 53.61 per cent. of radium element, while radium sulphate ($RaSO_4$) contains 70.20 per cent.

Radioactive bodies undergo profound transformations and their atoms disintegrate spontaneously while becoming transformed. Radium takes 1700 years to lose one-half of its weight. Its radiation may therefore for practical purposes be considered to be *constant.*

Radium Emanation.—Certain radioactive substances have the power of giving off continuously radioactive gases. Radium gives off a gas known as *emanation* or *radon.* This is set free only in small quantity from the solid radium salts. The emanation intended for introduction into the closed containers used in medicine is extracted by vacuum from the salts of radium placed in solution.

Radium emanation placed in a closed container emits a radiation which at first increases on account of the production of the A, B, C, etc., radiums, known as bodies of *induced radioactivity,* the radiation of which is added to that of the emanation.

The intensity of the radiation reaches a maximum in 3½ hours and then decreases steadily, in accordance with a fundamental law, diminishing by one-half in 3.82 days; this radiation is practically *nil* at the expiration of one month.

MESOTHORIUM.

Mesothorium, extracted from thorium ores, emits the same radiation as radium; its gamma radiation is, however, more penetrating than that of radium.

Its therapeutic properties are the same, but it exhibits a slow variation of its activity; commercial mesothorium, indeed, at first increases in activity for a few years, then decreases continuously. At the end of twenty years, it has but the half of its original power; it then continues to decrease, one-half being lost in about every 6½ years. Admitting that radium and mesothorium have the same therapeutic properties, the choice between them will depend solely on their availability, but the price of mesothorium does not seem to be much less than that of radium. Under these circumstances, the latter has the advantage of its greater longevity and of the constancy of its radiation.

Thorium-X.—Thorium-X is one of the products of disintegration of thorium; it gives rise to the thorium emanations.

Its life is very short; its activity increases about 10 to 20 per cent. during the first few days of its production, but diminishes thereafter at such a rate that after about 3½ (3.64) days it has lost one-half of its value.

Thorium Emanation.—Thorium-X gives rise to thorium emanation, the life of which is very short, and which diminishes by one-half in 54 seconds.

UNITS.

The *unit of radium* is the *gram of radium element.*

In therapeutics the usual unit is the *milligram of radium element.*

The unit of mesothorium is the quantity of the substance which produces a gamma radiation the intensity of which is the same as that of the gamma radiation of 1 gram of radium element.

The *unit of* radium *emanation* is the *"curie"*; it is the amount of emanation equivalent to 1 gram of radium element.

The volume of a "curie" of emanation is 0.6 cubic millimeter at 0° C. and at a pressure of 760 mm. of mercury.

As compared to the quantities of emanation employed in therapeutics the "curie" is a very large unit; therefore there is used more commonly the *"millicurie,"* which is the thousandth part of a curie, as well as units progressively smaller by one thousand times; thus, we have the millicurie, the microcurie, and the millimicrocurie.

One milligram of elemental radium produces 0.00755 millicuries of emanation per hour, a quantity which becomes destroyed during the same length of time.

One milligram-hour of radium emanation destroyed equals 0.00755 millicuries destroyed.

RADIUM EMANATION DISSOLVED IN MINERAL WATERS.

Radium emanation is disseminated throughout nature.

Certain mineral waters contain fairly large quantities of it.

The amount of emanation in the atmospheric air is from 1500 to 2000 times less than that of the gases obtained from the least radioactive mineral waters.

RADIOACTIVE MUD.

Radioactive Mineral Mud.—This is the residue of radium-bearing ores treated by chemical processes to extract the radium from them. They have a weak radioactivity, the amount of which is about 0.15 to 1, taking as unit the radioactivity of pitchblende.

Natural Radioactive Mud.—This is vegeto-mineral mud which is found in the vicinity of certain thermal resorts, such as Dax.

These muds or clays, used in the treatment of rheumatism by applications over the joints, often bring relief from the pain.

RADIOACTIVATED WATERS.

By various devices there can be produced streams of water charged with dissolved emanation.

One may use, for example, an apparatus similar to an inhaler, in which the emanation produced is carried along in the water by a stream of gas.

SOLUTIONS OF RADIOACTIVE SALTS FOR INJECTION.

Soluble or insoluble salts of radium and of mesothorium are used in doses of a few micrograms.

The preparations of insoluble salts should not be prepared in advance, since the suspended granules might become deposited on the sides of the ampule. Immediately before the injection, a solution of a soluble salt in a sterilized solution of sodium sulphate should be mixed *in the syringe*.

Thorium-X dissolved in physiologic salt solution is also used, particularly in the treatment of *pernicious anemia*.

APPARATUS REQUIRED.

The forms of apparatus used in therapeutics comprise:

(1) Apparatus containing radioactive salts.

(2) Apparatus containing the condensed emanation.

APPARATUS CONTAINING RADIOACTIVE SALTS.—These forms of apparatus comprise tubes, needles, and enamel preparations.

The **tubes** have a thickness of 0.5 millimeter of platinum and contain 1, 2, 5, or 10 milligrams of radium element (Fig. 99).

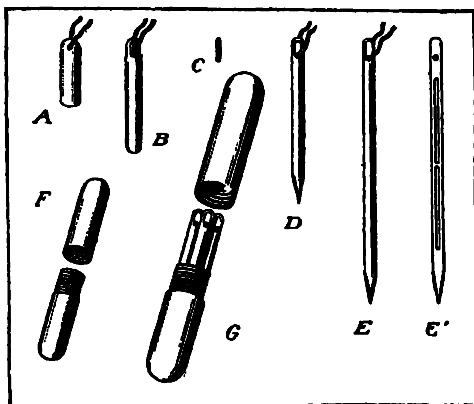


Fig. 99.—*A*, Platinum-walled tube of 0.5 mm. thickness containing 5 milligrams of radium element. *B*, Tube containing 10 milligrams of radium element. *C*, Ampule of thin glass containing condensed emanation. *D*, Needle with platinum walls of 0.5 mm. thickness, to hold 1 to 5 milligrams of radium element or 1 ampule of condensed emanation. *E*, Needle intended to hold end to end two radioactive foci, *viz.*, fine tubes each containing 1 to 2 milligrams of radium element, or ampules of condensed emanation. *F*, Gold case of a thickness equivalent to 1.5 millimeters of platinum, intended to hold 10 milligrams of radium. *G*, Case intended to hold five needles of 2 milligrams of radium element, equivalent to one tube of 10 milligrams.

They may be placed in supplementary cases, generally of gold, with walls 0.5 to 2 millimeters thick.

The **needles** are generally of platinum, with walls 0.5 millimeter thick; their diameter is less than that of the tubes, *viz.*, about 3 millimeters; one of their extremities, being pointed, permits of their direct introduction into the tube. The tubes and the needles are provided with an eye for threading with a silk or bronze thread.

The flat applicators, consisting of **enamels** in which the radium is incorporated, are preferable to the older devices formerly used which

involved fixation of the radium by means of glue or organic products. (Fig. 100.)

APPARATUS CONTAINING CONDENSED EMANATION. —The emanation extracted in a vacuum from the salts of radium is collected in fine glass capillary tubes (Fig. 99). These may be used bare, but are more usually inserted into tubes or metallic needles of varying thickness and size, thus constituting applicators similar to those containing salts of radium. But whereas radium yields a **con-**

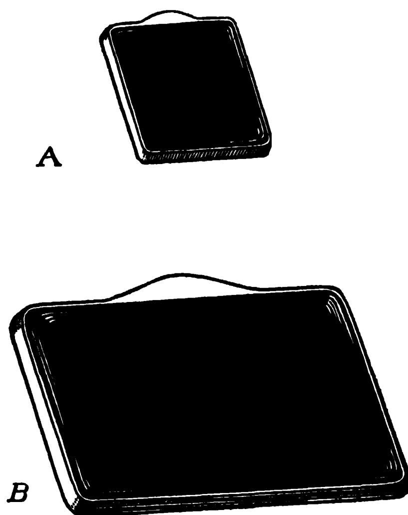


Fig. 100.—*A*, Enamelled applicator 2 x 2 centimeters, containing 16 milligrams of radium, or 4 milligrams per square centimeter. *B*, Enamelled applicator containing 15 milligrams of radium, or 1 milligram per square centimeter.

stant radiation, an ampule containing condensed emanation can furnish only a **temporary** radiation, which diminishes by one-half in 3.82 days and is practically *nil* at the end of a month.

FILTERS.

The absorption of the beta and gamma rays being approximately proportionate to the specific gravity of the absorbent material, the fraction of radiation transmitted through the walls of the tubes depends upon their thickness and their composition. Thus, the fraction of radiation absorbed by 1 millimeter of lead, with a specific gravity

of 11.36, is about the same as that absorbed by 0.5 millimeter of platinum, with a specific gravity almost double that of lead—21.5.

The filtering substances most commonly employed are *platinum, gold, lead,* and *aluminum.*

Platinum and gold make up the walls of the tubes and needles employed especially in applying gamma radiation.

Lead is often used extemporaneously to increase the filtration of an applicator.

Aluminum is used only in the treatment of superficial affections, and eliminates only the softest beta rays.

Secondary Filters.—When the applicators are placed over the skin or a healthy mucous surface, they have to be covered with some material of low specific gravity intended to intercept the secondary rays, the softest rays, which are irritating to the tissues. *Gauze,*



Fig. 101.—*A*, Tube rolled up in gauze 0.5 centimeter thick, the latter being intended to absorb the secondary radiation. This type of apparatus is used for vaginal irradiations. *B*, Tube placed inside a cork plug. Also used for vaginal irradiations.

cork, rubber and *plastic substances* which are used to make moulds of the regions to be irradiated are suitable for arresting this secondary radiation (Fig. 101).

DESIGNATION OF THE CONSTANTS OF A RADIUM APPLICATION.

1. When an application of a radium salt is to be made, there are recorded: (*a*) The **weight of radium element** contained in each applicator.

(*b*) The duration of the application, whence is deduced:

(*c*) The **total energy expended,** expressed in **millicuries consumed.**

Example: 20 milligrams of radium applied during 72 hours, or 1440 milligram-hours, whence is deduced the number of millicuries destroyed:

$$1440 \times 0.00755 = 10.8 \text{ millicuries destroyed } (\text{mc}\delta).$$

2. When the applications are being made with applicators containing condensed emanation, there should be noted:

(*a*) **The initial amount** (Q_1) of emanation.

(*b*) **The duration** (*t*) of the application, which allows, by means of a special table, of ascertaining the final quantity (Q_2) of emanation, whence is deduced:

(*c*) The **total energy expended,** expressed in millicuries destroyed.

Example: $Q_1 = 125$ millicuries. Time of application $= 22$ hours.

Special tables show the quantity (Q_2) remaining after 22 hours, or 106 millicuries. The quantity destroyed will be, therefore, $125 - 106 = 19$ mcd.

To these specifications must be added the *thickness* and *nature* of the filters interposed, the *exact distance* of the applicators, and their *position* with relation to the tissues, in order that the application may be repeated under the same conditions.

GENERAL BIOLOGICAL EFFECTS OF THE RADIATION.

Radium rays produce different effects on the living cell, according to the dosage used.

1. In **excessive dosage,** they are capable of killing all the living cells.

2. In **selective dosage,** the action of the radiations is manifested by a more or less rapid death of the susceptible cellular elements. The selective action is the property possessed by the radiations of exerting a more intense action on certain cells than on others. In other words, the cells possess a very unequal sensitiveness to the radiation: The sensitiveness of the tissues to the radiations is greater according as they are rich in reproducing cells. This is why the radiation has an elective action on certain tumors, the cells of which are actively multiplying.

3. In an **inhibiting dose,** insufficient to bring about death of the cellular elements, the action of the rays is manifested in a delay in the multiplication of the susceptible cells, *i.e.*, in an *inhibition,* which is only temporary, of their reproductive power.

4. In **small dosage,** the radium rays and the X-rays possess an excitant property and stimulate nuclear division.

Vaccination.—The sensitiveness of a tissue to the action of the radiations is not always the same. The radium-sensitiveness of cancers decreases in the course of successive applications. Previous applications, if they have been insufficient, render extremely difficult, if not impossible, the sterilization of cancers. The healthy tissues, on the other hand, become more and more vulnerable, and cannot withstand with impunity repeated doses of radiation.

INDICATIONS FOR RADIUM TREATMENT.

I. CANCER.

As soon as a lesion appears suspicious and the possibility of cancer is suspected, a diagnosis should be reached by examination of the living tissue, *i.e.*, by a biopsy.

Biopsy.—This consists in cutting away a fragment from the border of the lesion, conserving as much as possible the tumor and the adjacent tissue.

The fragment obtained should be placed at once in a bottle containing a fixing fluid (formaldehyde, 10 per cent.; commercial formaldehyde being of 40 per cent. strength, it need merely be diluted four times with water), and sent to a competent laboratory with the clinical data useful for orienting the researches of the histologist, *e.g.*, from what organ the fragment had been taken, the appearance of the lesions, and a few words concerning the clinical history of the disease.

In no case should a "test" antisyphilitic treatment be previously given, even if the patient is a known syphilitic. Not only is valuable time thus wasted, but the risk is run of aggravating the disease, this treatment sometimes markedly stimulating the growth of the neoplastic lesions. A biopsy alone permits of a correct and early diagnosis.

General Technic of Radium Application.—1. Knowledge of the phenomena of vaccination of the neoplastic tissues against the radiation affords ground for the following rule, which must be considered as absolute: *Endeavor to obtain the desired therapeutic effects with the initial application or a first series of irradiations, giving the maximum dose compatible with repair of the healthy tissues and with a good general condition of the patient.*

2. The possibility of producing phenomena of excitation or temporary inhibition of the neoplastic cells when these have received an insufficient dose of radiation makes it necessary to employ an *irradiation as nearly even as possible of the whole tumor,* in order to reach its deeper parts and peripheral prolongations.

This object is rather difficult to attain by reason of the rapid diminution of intensity of the radiation in the *inverse ratio to the square of the distance.*

There are various ways of overcoming this difficulty:

(*a*) **Application of Radium from a Distance.**—Remoteness of the source of the rays in a certain measure equalizes the amount of rays received at the surface as well as deeper in. This procedure is similar,

as a matter of fact, to an application of heavily filtered X-rays. It consists in irradiation by means of a large quantity of radium placed a few centimeters away from the lesion to be irradiated.

Little practised in France, this technic necessitates the use of very material quantities of radium, sometimes even several grams, placed at a distance of 10 or 15 centimeters.

(*b*) **Surface Application of Radium.**—This procedure is utilized for irradiations of relatively shallow lesions, or where it is possible to use a number of applicators the radiations from which cross each other in the depths of the tissues (cross-fire method). For small

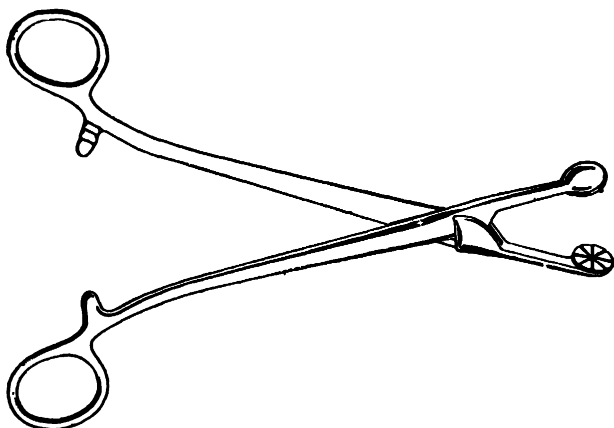


Fig. 102.—Bérard forceps with grooves, enabling the operator to lay hold of the needles and orient them in different directions.

lesions, these applications are made either with the enamel applicators or by means of tubes or needles placed side by side on a support of the same dimensions as the lesion under treatment (sheet of aluminum, rubber, or lead covered with gauze), over which they are held in place by means of adhesive plaster.

For surface applications over extensive regions, a species of mould is made over the parts with a plastic substance to which the applicators are fastened either with paraffin or adhesive plaster.

(*c*) **Radium Puncture.**—This is a procedure consisting of the introduction of the radioactive apparatus into the depths of the morbid tissues, in order, as much as possible, to equalize the irradiation.

The needles are inserted directly by means of special forceps. The tubes are inserted with the aid of a trocar.

To the tubes and needles is affixed a thread with which they may be withdrawn or fixed in place.

The content of active product (emanation or radium salts) in each applicator is, of course, the smaller according as the number of applicators introduced is increased.

In America, resort is had to the introduction of *bare* glass tubes of emanation which are left in the tissues until completely exhausted.

3. The *duration* of the application depends on many factors.

Some observers employ massive irradiations—one or more grams for a few hours. This procedure seems dangerous.

Others use a very slow method, *viz.*, an irradiation of feeble intensity continued over several weeks.

Applications on an average of from five to fifteen days are suitable in the majority of cases.

Cancer of the Skin.—Whether skin cancers be of the basilar-celled or squamous-celled type they should be treated by radiation. In the squamous-celled type, radium gives better results than X-rays; it should be employed even when the lesions are limited and consequently operable. In surgery, indeed, to prevent recurrence, the excision must be wide and extend beyond the visible margins of the neoplasm; it is therefore always attended by much loss of tissue and sometimes pronounced deformities, which plastic repair may sometimes improve but not remove entirely. On the contrary, properly conducted irradiation permits of a positive cure of this form of cancer, while protecting the patient from recurrence perhaps even more than surgery. Furthermore, and most important because these tumors generally occur on the face, radiation affords cosmetic results which are sometimes surprising (Fig. 104).

In superficial and but slightly infiltrating cancer, surface applications are practised.

In the granulating forms, it is better to resort to the introduction of radium apparatus into the neoplastic mass (radium puncture).

Precancerous Lesions.—Warts, when they become covered with a little scale which falls off and is then renewed; patches of senile keratosis when covered with a crust, or the presence of an erosion resembling an injury by a finger-nail, refusing to heal, should lead to apprehension of the development of cancer and be treated by radium.

Cancer of the Mouth.—Cancer of the lips, cheek, or tongue generally begins as an ulceration. It develops frequently in a leukoplasic patch, or is often mistaken at the outset for an ulceration of dental origin. A biopsy will remove any doubt.

Cancers of the lips, cheek and tongue are cured by radium if they can be treated sufficiently early.

When glandular involvements exist the chances of cure are very much diminished.

The treatment consists of:

(1) Irradiation of the lymphatic regions with radium placed on wax or paraffin applicators 1½ to 3 centimeters thick and conforming themselves in shape to the region.

(2) Treatment of the primary focus by radium puncture in the case of cancer of the tongue, or by surface application in the case of cancer of the mucosa of the cheek, for example.

Cancer of the Uterus.—Cancers of the body of the uterus are above all amenable to surgery. Cancer of the cervix must be treated by radiation.

1. **In the circumscribed, operable cases,** radium therapy applied alone often permits of obtaining a cure. Hysterectomy is nevertheless indicated, within the three weeks following the irradiation



Fig. 103.—Rubber sound containing end to end three tubes, each of 5 milligrams of radium, with walls of platinum 2 mm. thick. For insertion into the cervico-uterine canal.

Preoperative radium therapy, by sterilizing the zone of neoplastic invasion, adds a considerable element of security against the appearance of recurrences *in situ* and against the risks of infection of the peritoneum.

2. **In the inoperable forms,** radium therapy in conjunction with X-ray treatment affords a cure in about 34 per cent. of the cases.

The treatment consists in carrying out:

1. Irradiation of the parametria and of the lymphatic regions by penetrating rays.

2. Uterovaginal radium therapy by means of:

(*a*) An intrauterine rubber sound containing end to end two or three tubes each containing 5 to 10 milligrams radium (filter: 2 millimeters of platinum). (Fig. 103.)

(*b*) Tubes placed in the culs-de-sac, containing, according to the cases, 5 or 10 milligrams of radium (filter: 2 millimeters of platinum + cork or gauze). (Fig. 101.)

The application is continued for six days to two weeks, according to the case.

(3) **In the very advanced forms,** the extent of the lesions makes a cure hopeless, but penetrating radiotherapy in moderate doses often brings about marked palliative results, and in particular a cessation of the pain.

Cancer of the Breast.—Epithelioma of the breast does not react to the radiations in a sufficiently uniform manner to warrant their recommendation at present in cases still operable, in which surgical excision often gives excellent results.

In the inoperable forms, and in recurrences, radiotherapy may be of great service. Because of the large surfaces to be irradiated, the X-rays are generally employed. Irradiation after operation should be practised with great care in order to avoid recurrences at the periphery of the irradiated zones.

Cancer of the Alimentary Canal.—Only cancers of the esophagus and of the rectum, of all the neoplasms of the alimentary canal, are treated with radium.

Cancer of the esophagus may be benefited by the use of radium or of deep radiotherapy. The treatment consists in the placing *in situ* of a chain of tubes contained in a piece of rubber catheter. It is almost always necessary to perform beforehand a gastrostomy, so as to permit of feeding the patient during the period of the application. Permanent cures can scarcely be hoped for, but the prospects of improvement with survival for from twelve to eighteen months are hopeful.

Cancer of the rectum in its operable forms should be turned over to the surgeon. In its inoperable forms, the treatment should be preceded by the making of an artificial iliac anus; radium then sometimes gives unhoped for results which may lead to the belief of a permanent cure.

The treatment consists in the irradiation of the lymphatic regions by penetrating radiotherapy and in the insertion of a rectal sound containing a string of radium tubes. The iliac anus, previously established, permits of prolonging the irradiation for the necessary number of days.

Connective-tissue Cancers.—The **lymphocytomas,** *i.e.,* sarcomas of the lymph-nodes or of the hematopoietic organs, are particularly radiosensitive and yield very easily to radium or X-ray treatment, which should be preferred to surgery. Whether they be treated with the X-rays or by surface applications of radium, the irradiation should extend considerably beyond the visible limits of the tumor.

Unfortunately, the local cures obtained are often followed by the development of remote metastases.

The **sarcomas**, in which predominate bony tissue (osteosarcomas) or the collagen fibers (fibrosarcomas), are resistant to radium; in these cases surgery has generally to be resorted to.

CONTRAINDICATIONS TO THE TREATMENT OF CANCER BY RADIATIONS.

Contraindications of a Local Order.—Certain forms of cancer which are especially refractory to the action of radium should not be treated with it. Such are the nevocarcinomas.



Fig. 104.—Epithelioma of intermediate type following senile keratosis. *Treatment* (November, 1923): Combination of radium puncture and surface applications: 1, Insertion of two needles, each of 2 milligrams of radium, into the base of the tumor. Filter, 0.5 millimeter of platinum. 2, Surface apparatus consisting of three needles, each of 2 milligrams of radium fastened to a 1-millimeter sheet of lead lined with gauze 0.5 centimeter thick. Filter, 0.5 millimeter of platinum. Exposure: 10 days.
In all, 10 milligrams of radium for 10 days (or 18 mcδ).
Rapid healing without reaction in the surrounding tissues.
The patches of keratosis were treated by the application of the apparatus *A*, shown in Fig. 101, with a filter of 0.3 millimeter of aluminum and 2 millimeters of cardboard, for a two-hour period.

The presence of pigment in a malignant tumor constitutes a contraindication to the use of the rays, as well as, indeed, to surgical excision. *Electrolysis* alone may arrest the development of the tumor when it is still circumscribed. Irradiation or any other form of interven-

tion causes extension of the tumor, favors rapid growth of metastases, and precipitates the death of the patient.

Risk of Perforation of the Walls of an Organ.—This is a complication observed when the walls are completely invaded by the neoplastic process. In these cases radium therapy must not be employed.

Contraindications of a General Order.—Cachectic patients or patients whose general condition seems too greatly impaired, especially those showing a *marked cellular anemia,* should be irradiated only with extreme caution. They may, indeed, not be able to endure the destruction of blood cells produced under the influence of large doses of rays, and the absorption of the toxic products sometimes seriously aggravates their condition. Radiotherapy in these cases may even precipitate the fatal termination.

The same applies to cancer complicated by *infection,* especially in cancer of the uterus. Radium therapy aggravates the local infection and may bring on a pelvic peritonitis leading to death.

Metastases.—The finding of a metastatic focus, unless it may itself be treated by radiotherapy, is a contraindication to the use of radium. It is well known, indeed, that regression of the principal tumor often has as consequence a more or less rapid development of the preexisting metastases; when the latter are situated in the viscera or when they are scattered, radiotherapy can only shorten the patient's life.

II. UTERINE DISORDERS.

Aside from cancer, radium also yields very favorable results:

1. In hemorrhage due to the presence of **fibromyomas.**
2. In **hemorrhage of the menopause.**

Radium brings about clinical cure of uterine fibromas by inducing a premature, artificial menopause and gradual atrophy of the tumor.

The best results are observed in hemorrhagic fibromas of small or intermediate size.

It is often necessary, however, in order to be sure of the diagnosis, to have recourse to a intra-uterine biopsy, the hemorrhagic metritis of the menopause coming on at precisely the same age when cancer of the body of the uterus develops. Again, the physician must, by careful examination and questioning of the patient, make certain that there are no foci of old salpingitis, radium treatment being liable to reawaken a latent infection.

It is generally not necessary to introduce radium into the uterine cavity; the artificial menopause is induced by irradiation with radio-

active applicators placed in the vaginal culs-de-sac. Two tubes, each of 10 milligrams of radium, with a filter of 2 millimeters of platinum + 1 centimeter of gauze, used in one treatment of five or six days' duration, are usually sufficient to bring on the menopause. The dressing must, of course, be renewed daily.

III. BENIGN TUMORS.

Erectile Angiomas.—Radium constitutes the best treatment for the erectile or tuberose angiomas.

It is not painful and gives perfect cosmetic results.

It is best to employ *brief* applications of the radiation, with little filtration, never going so far as a caustic action. The looked-for result being, above all, esthetic, any reaction which might favor the appearance of telangiectases and pigmentation must be avoided.

Prolonged applications over the face, head, or epiphyseal cartilages in young children should never be made.

The enamel applicators are, in these cases, extremely convenient to use; they yield a more uniform irradiation than tubes placed side by side.

In treating an angioma of the size of a hazelnut, for example, one may, after having first protected the healthy skin with a shield of lead 1 millimeter thick, lined with cardboard, apply over the angiomatous tumor an enamel applicator containing 4 milligrams of radium element per square centimeter, with a 0.1 millimeter aluminum filter. Two applications of 30 minutes each, one week apart, are generally sufficient to bring about disappearance of the angioma. One must take care, however, to wait *several months* before beginning a new course of applications, as the disappearance of the angioma sometimes takes place only at an extremely slow rate.

Port-wine Marks.—With radium these can be decolorized, but the treatment is one of very long duration, the applications having to be spaced far apart. The patient should be warned of this.

Enamel applicators may likewise be used, but it is well here to employ a somewhat more heavily filtered radiation, as by 0.5 millimeter of lead, together with cardboard and gauze, in applications of 5 to 6 hours' duration. One must not attempt to get a complete decolorization, but should stop when a pinkish tint has been obtained.

Keloids.—Prominent, red keloids, often so unsightly, easily yield to the action of radium.

Radiation filtered with a minimum of 0.5 millimeter of platinum should be employed, in applications of twenty to twenty-four hours each.

Along with the keloids may be mentioned *vicious scars,* and contracting bands, which are often considerably reduced by the use of radium.

IV. SKIN DISEASES.

Lupus.—Radiation by radioactive substances has no elective action on the lupic tubercle.

Nevertheless, by acting in such a manner as to destroy the morbid tissues, radium gives favorable results in some ulcerated or granulating forms. The scars are particularly soft. In lupus erythematosus a cure is rather easily obtained.

In these cases it is best to employ the radiation with relatively little filtration, *e.g.,* by 0.5 millimeter of lead together with cardboard 2 millimeters thick. The irradiation effected with the enamel applicator *A* shown in Fig. 100, applied in this manner during twelve hours, induces a rather sharp reaction, with the formation of a thin scab which, upon falling away, generally leaves a soft scar. It is sometimes necessary to renew the application at the end of six weeks.

Pruritus.—Localized pruritus *sine materia,* such as that involving the vulva or anus, yields in a remarkable way to brief applications of radium with little filtration. With the applicator *B* shown in Fig. 100, a 10-minute application over the pruriginous region, with the radiation filtered solely by a piece of cardboard 1 to 2 millimeters thick, generally brings about a cure.

The result is obtained very rapidly even in the cases where the pruritus has existed for several months.

V. GONOCOCCAL RHEUMATISM.

Too little known, the treatment of gonorrheal rheumatism by radium, whether in the acute or subacute forms, brings about surprising recoveries. There is noted, indeed, rapid disappearance of the pain, thanks to which the limb can be mobilized and ankylosis avoided.

In old cases radium produces a favorable effect in diminishing the pain; it has no effect, of course, on established fibrous ankylosis.

The treatment consists in applying over the diseased joint a series of tubes, each of 5 or 10 milligrams of radium, filtered by 2 millimeters of platinum + 1 centimeter of gauze, left in place for twenty-four to forty-eight hours, according to the case.

Results are almost immediate, gonococcal arthritis being *remarkably* sensitive to the action of the radiation from radioactive substances.

X-RAY THERAPY.

By A. Lomon, M.D.

On account of the rather costly outfit required, as well as for lack of time, the Röntgen rays are, as a rule, available for therapeutic use only to those specializing in this branch.

The X-ray treatment of deep-seated malignant tumors requires an armamentarium different from that used for diagnostic purposes, *viz.*, one capable of supplying at a tension equivalent to 40 centimeters of spark a curative dose of the rays at one sitting or in several sittings distributed in the course of about one week. Such outfits are as yet relatively few.

The non-specializing practitioner should be familiar with the modes of action of X-ray therapy and the disorders which must or can be treated with the X-rays. He watches and checks up the effects of the treatment on his patient. But the modalities of application, which vary with the disorder present, the region affected, and the equipment, and furthermore, are almost constantly being modified in the light of added experience, remain the province of the specialist.

I. MODE OF ACTION OF THE RAYS.—Physical Factors.— The X-rays are a special form of energy produced by a transformer known as the X-ray tube.

The rays emitted by an X-ray tube are made up of, not a single, but a group of radiations. These radiations represent a non-periodic vibration of the ether, similar to the gamma rays given off by radium, and the wave-length of which is very short, *viz.*, less than 0.005 micron. They consist of a mixture of rays of varying penetrating power. The *penetrating* rays pass through the tissues without losing any significant amount of their intensity. They give up little of their energy in the tissues; a large amount of them would be required to produce distinct changes, *but at least their action is of almost the same intensity in the deep tissues as at the surface.* The *rays of low penetrating power* lose much of their intensity in passing through the tissues. They give up much of their energy in the process; relatively little of them is required to produce an effect on the tissues. *But their action is very intense in the superficial layer of tissues, while very feeble in the deep structures.*

The quantity of the rays arrested depends upon the quality of the rays (which vary in penetrating power) and upon the quantity of the incident rays.

The *diseased* tissues to be treated often lie deeply beneath *healthy* tissues that must be spared. The superficial healthy layer of tissue will, however, receive a stronger dose of rays than the diseased deeper layer upon which the therapeutic action is to be exerted, be-

cause it is nearer the source of radiation (law of the square of the distance) and because it arrests the less penetrating rays. The attendant risk is obviated:

1. By using rays of high penetrating power.
2. By filtering the rays, *i.e.*, by interposing between the skin and the tube a sheet of aluminium 1, 2 or 3, up to 10, millimeters in thickness, which arrests the least penetrating rays.
3. By using several distinct portals of entry so as to make successive doses of the rays converge upon the area under treatment.
4. By virtue of the greater sensitiveness of certain tissues to the rays—generally a pathologic sensitiveness, *i.e.*, thanks to the histo-physiologic factor.

Histo-physiologic Factors.—*The X-rays exert a destructive action on living cells* (though in small doses they may exert a stimulating action). This action is SELECTIVE, and the cells that are most sensitive to the X-rays are the following:

1. Cells pathologically hypertrophied in matured organs or organs in process of formation.
2. Neoplastic cells.
3. Cells in process of formation.
4. Epithelial or endothelial cells; the younger these cells, the more manifest their sensitiveness. The subjoined table summarizes in an approximate, schematic manner the relative degrees of sensitiveness of the normal and pathologic tissues.

	EXTREMELY SENSITIVE.	RELATIVELY SENSITIVE.	NORMALLY SENSITIVE.	BUT SLIGHTLY SENSITIVE.
Normal Tissues.	Testicle, ovary, spleen. Lymphatic glands. Bone marrow. Cartilage in the stage of ossification.	Thymus. Thyroid.	Skin. Hair-follicle.	Bone. Muscle. Matured cartilage.
Morbid Tissues.	Swellings of leukemia and Hodgkin's disease. Mycosis fungoides. Lymphosarcoma. Adenosarcoma of the testicle. Recent psoriasis.	Tuberculous lymphoma. Simple lymphoma. Hypertrophic lupus. Favus and sycosis. Keloid. Inflamed skin.	Myoma. Fibroma. Chondrosarcoma. Myosarcoma. Fibrosarcoma. Osteosarcoma.	Lipoma. Atrophied skin.

II. GENERAL PRINCIPLES OF RADIOTHERAPY.—The action of the X-rays is exerted powerfully on cells which are undergoing division by karyokinesis. The more specialized the activity of the cell with a view to its division, the more pronounced the action of the rays. If the dose is sufficient, the cells are killed and disappear by absorption. The X-rays have less effect on mature cells which have attained their permanent form.

Radiotherapy is advisable only under the following conditions:

Either: The cells to be destroyed must constitute a homogeneous and superficial tissue which can be treated *en bloc*, with the surrounding normal tissues easily protected.

Or: If the type of cell to be destroyed forms only a part of a tissue made up of complex components, this type of cell must be featured by karyokinetic activity. The tissue is treated with doses of the rays sufficient to kill the undesirable component but compatible with integrity of the healthy components.

The **number** and **duration** of the X-ray treatments vary according as one is dealing with a superficial lesion which has infiltrated the skin or a deep-seated tumor concealed by a varying thickness of overlying tissues.

In the first instance, a massive dose may be given and the number of treatments greatly restricted. A single treatment may sometimes be sufficient. In the second instance, the treatment is feasible only if the sensitiveness of the morbid cells to the X-rays is greater than that of the neighboring healthy cells. It will be facilitated if it is possible to have the incident rays converge through several ports of entry. It requires a varying number of treatments—5, 10, 20, or sometimes more.

Unless he is thoroughly familiar with the highly complex problems of X-ray therapy, it is well for the attending physician not to forecast the modalities of application required and to avoid informing the patient as to the number and duration of the treatments without having first consulted with the radiologist.

Histologic examination should always precede X-ray treatment: *Biopsy is a necessary procedure.* It shows what the proper treatment should be; thus, the X-rays or radium may be expected to fail or yield a very satisfactory result according as the growth is a squamous cell or a basal cell epithelioma. It may be said roughly that epitheliomas of the basal-cell type with ulceration are cured by properly conducted X-ray treatment better than by surgery, and that those of the elevated variety, while more resistant, nevertheless

yield to the X-rays or to radium. On the other hand, the epidermoid or squamous cell cancers, under X-ray treatment, even when well conducted, either prove failures or show apparent recoveries followed by early recurrence, so that surgery in this lesion retains all its prerogatives, and it is only in the case of a growth inoperable by reason of its situation or its extent that radiotherapy should be resorted to from the start.

Experience, coupled with recent advances in technic, is tending to reduce the number of X-ray treatments given in cases of malignant growths. The dose sufficient for destruction of the tumor should be given at one sitting or at a few sittings in close succession. It appears, indeed, though this has not yet been positively demonstrated, that repeated applications of the X-rays vaccinate the tumors against their action, *i.e.*, render them less radiosensitive, while at the same time the healthy cells become much more radiosensitive.

The treatment of cancer (breast, uterus, tonsils, etc.) by the X-ray requires on the average fifteen hours of application spread over a week. The patient must be warned that these applications are uncomfortable; that they necessitate immobility in positions which, as time elapses, become fatiguing; that toxic symptoms such as nausea and vomiting, generally appear about the second or third day; that the application is made not only at the seat of the disease, but over a large area (for the breast, the whole half of the chest), and lastly, that towards the fifteenth or twentieth day, itching, a marked erythema, and sometimes elevation of the epidermis by bullæ which may become infected, or a complete desquamation of the skin, are the usual, yet very disagreeable, accompaniments of the X-ray treatment of malignant tumors. It is preferable, whenever possible, that the patient be hospitalized in a special institution for the duration of the treatment or during the week following the conclusion of the treatment.

* * *

III. APPLICATIONS OF RÖNTGEN THERAPY.—There are some disorders in which the X-ray constitutes an important therapeutic factor. In these it **must be prescribed** either because it is the essential part of the treatment or because it may be a very effective adjunct to it, of which the physician does not have the right to deprive the patient.

There are other disorders in which X-ray treatment constitutes an alternative therapeutic measure. Under these circumstances the physician **may have recourse** to the X-ray:

1. *Because it has to its credit recoveries and instances of positive improvement.*

2. *Because the other procedures have been tried without result.*

3. *Because the other methods of treatment are not applicable in the individual case.*

Indications for, Prognosis, Effects and Duration of Treatment in the Main Disorders Treated with the X-Rays.—Malignant Tumors.— These should as much as possible be removed surgically. But:

1. Every operation should be followed by postoperative X-ray treatment.



a *b* *c*

Figs. 105 to 107.—Epithelioma of the horny type at the outer angle of the eye.

a, before treatment (lesion of five months' standing).
b, seven days after the first X-ray treatment.
c, forty-five days after the beginning of X-ray treatment. Healing is complete. The patient received three X-ray treatments, making up a total dosage of 22 H after filtration through 1 millimeter of aluminium.
Seen again thirty months later, the patient showed a pliable, unpigmented scar, without any trace of recurrence.

2. If the operation is put off for any reason, the patient should undergo X-ray treatment without delay.

3. Inoperable cases will always derive benefit from X-ray treatment; some will be rendered operable.

4. Recurrences will also derive benefit from X-ray treatment.

In short, X-ray treatment is the necessary complementary measure to all surgical operations on malignant growths. In the absence of surgical removal, it remains a treatment of choice.

Epithelioma of the papillomatous, verrucose or horny types, flat cicatricial epithelioma, and rodent ulcer are being treated and cured with the X-ray. The results are especially striking and prompt where the lesion is well circumscribed and not too extensive. Massive doses can be given under these conditions. Growths developing at the margins of the natural cavities of the body, growing in deeply and reaching the lymph-nodes, should be treated with the X-rays in heavy dosage and with rays of high penetrating power; the lymphatics should also be irradiated.

Mycosis Fungoides.—*X-ray treatment is the only treatment* for this condition. It permits of prolonging for years the life of a patient who would formerly have been doomed. Recurrences may take place, with appearance of fresh tumors at points not treated, or metastases. These should be followed up with further X-ray treatment. Where the disease is of limited extent, a single irradiation will bring about lessening of the itching and discharge in a few days. The ulcers heal in a few weeks, soft skin replacing them.

Cancer of the Breast.—If operation is possible, nothing should be allowed to delay it, but postoperative X-ray treatment should be begun as soon as possible, over the scar, the axilla and the supraclavicular region.

If recurrence takes place after the operation in the form of small outgrowths in the vicinity of the scar, the X-rays will cause these lesions to disappear. In a later stage it will heal beginning ulcerations.

Where the age of the patient, extension of the growth or cardiac or renal complications necessitate postponement or abandonment of the operation, X-ray therapy should always be prescribed. If the growth is ulcerated, the ray will heal the ulcers and dry up the discharge; it will also allay the pain. It does not cure mediastinal extensions of the tumor, but retards the fatal issue.

In the case of a cancer without ulceration, reduction of the growth, subsidence of the lymph-nodes and improvement of the general condition are observed. The result is not a cure, but a condition approaching it, and which may be maintained for a long time.

Preventive postoperative irradiation after excision of cancer of the breast, when given intensively, in one exposure or in a few exposures at short intervals, seems to accelerate recurrence. According to A. Béclère, irradiations of feeble intensity and in fractional dosage obviate recurrence *in situ,* but do not prevent recurrences in remote regions.

Paget's Disease.—At the start, when the disease is limited to the areola, recovery is practically certain.

Deep-seated Cancers of the Uterus, Rectum, etc.—If only the ordinary X-ray outfit is available, X-ray treatment should not be undertaken, except in inoperable cases, because here the mental factor must not be given up and the pain can be reduced.

If apparatus for deep X-ray therapy operating with a current of about 200,000 volts can be employed, such therapy can be selected as the mode of treatment to be used, by agreement between the attending physician, the surgeon and the radiologist. A single treatment of several hours' duration, or two or three exposures within a few days, with a very extensive irradiation, filtration of the rays through 1 millimeter of copper or 1 centimeter of aluminium, and measurement of the dose of rays absorbed by iontometric procedures, yields quite remarkable results. X-ray and radium treatments should be combined according to existing indications.

Sarcoma.—The rapidity with which some sarcomas retrogress under the influence of the X-rays is amazing. The tumors most sensitive to this action are the sarcomas of the skin and the lymph-nodes (sarcomas of the mediastinum). The reduction of volume and relief from the pain and pressure phenomena is often extremely rapid (in a few days). Unfortunately, recurrences and metastases are frequent.

Benign Tumors.—Myoma of the Uterus.—In the treatment of uterine fibromyomas, aside from the exceptional conditions urgently demanding surgical intervention, X-ray therapy is the treatment of choice and the only one which is applicable to nearly all the cases and nearly always yields a cure without risk, without pain, and without the least disturbance of the habits of life or interruption of the ordinary occupation of the patient (A. Béclère).

On the tumor element, the result is reduction and sometimes complete disappearance.

On the hemorrhagic element, ordinarily after three months' treatment, but frequently less, cessation of the ovarian function takes place, with elimination of the metrorrhagia and menses.

1. X-ray treatment of a hemorrhagic myoma is *indicated* in all old or anemic women; in all women, whether young or old, suffering from pronounced heart disorders, diabetes mellitus, chronic nephritis or serious lung lesions.

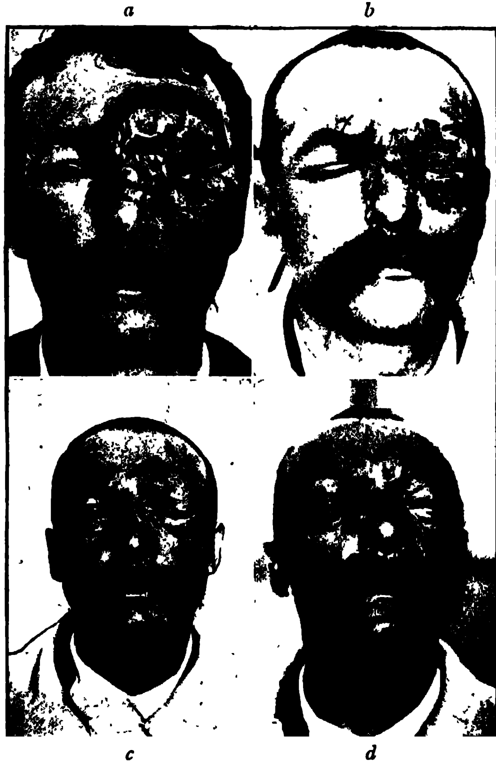
2. It is *contraindicated:*

a. In cases of pedunculated tumors which can readily be excised without prejudice to a possible later pregnancy.

b. In cases of gangrenous myomas or myomas that have undergone malignant change.

c. In cases of myoma combined with pronounced disease of the adnexa.

d. In myomas creating such disturbances that the life of the patient appears to be placed in jeopardy by the lapse of the two or three months required to obtain results with the X-rays.



Figs. 108 to 111.—Round-celled lymphosarcoma.

a, extensive growth originating in the nasal cavities (a drop of blood is visible in the left nostril). A tumor running a rapid course and extending beyond the median line; the eye is unrecognizable and is supposed to be destroyed.

b, fifteen days after the beginning of X-ray treatment. The growth has subsided and diminished in size by one-half. The involved portion of the right eyebrow, which was not within the zone of irradiation, remains prominent; it shows a scar, resulting from the removal of a specimen of tissue.

c, at the twenty-fifth day of the treatment, healing is almost complete and the lids have reformed.

d, at the thirty-fifth day, after three X-ray exposures, healing is complete; the tumor is, however, extending in the deep tissues, and there is noticed some distortion of the face and the appearance of a nodule at the nasolabial sulcus.

Recurrence is frequent in these very malignant tumors.

A careful gynecologic examination is necessary to avoid overlooking an incipient malignant tumor.

The prognosis is very favorable when reduction of size is observed in the first few weeks of the treatment.

The duration of the treatment is from three to six months.

Tuberculous Conditions.—LUPUS.—The X-ray exerts a favorable effect in some forms of lupus—the raised, hypertrophic forms. The X-ray is an agent which it is well to combine with other kinds of treatment, particularly scraping and the curet.

TUBERCULOUS ADENITIS.—Here the rapidity and uniformity of the successful results are striking.

(*a*) TUBERCULOUS ADENITIS WITHOUT SUPPURATION.—Reduction of the size of the swellings takes place rapidly as a result of the first few X-ray treatments. Frequently a slight inflammatory reaction is observed in the 48 hours following the irradiation. *Complete* disappearance of the glands is not always obtained and there remains a chain of hard, fibrous nodes. Recurrence is a possibility, but readily yields to further treatment.

(*b*) TUBERCULOUS ADENITIS WITH SUPPURATION.—Puncture and evacuation are required, but under the rays the walls of the abscessed nodes are seen to be absorbed and the neighboring non-abscessed glands diminish in size. Healing is obtained without prominent scarring, keloid or contraction. The cosmetic result is far superior to that following the other methods of treatment.

(*c*) ADENITIS WITH SINUS FORMATION AND ULCERATION.—The action is no less striking in its results and in the excellence of the scar. A febrile movement is sometimes noted a few hours after the irradiation. It appears to be due to the passage of absorption products into the circulation.

TUBERCULOSIS OF JOINTS.—Especially the white swellings of the tibiotarsal region, knee and wrist. The pain is relieved and the contracture then passes off. The local temperature is reduced, and likewise the infiltration. The sinuses close. The results are very brilliant in the ankylosing forms of the disease.

TUBERCULOSIS OF BONES.—Fluctuating abscesses should be evacuated by puncture. But if there is suppuration and even sequestra, the process dries up and the sequestra are eliminated under the X-rays. Spina ventosa and tuberculosis of the tibia and bones of the foot are cured completely. The duration of the treatment is about six months.

Leukemia.—In myeloid leukemia, the results are greatly superior to those of all other procedures. In a few months the following are restored to normal: Size of the spleen, appetite, physical strength,

weight, hemoglobin percentage and erythrocytes. The number of leukocytes drops to 5 or 6000. A few myelocytes remain, however, showing that the patient is not completely cured.

In acute leukemias, the treatment may be tried, but the course of the disease seems to be fatal.

Diseases of the Endocrin Organs.—EXOPHTHALMIC GOITER.—The pulse-rate becomes slower, the tremor disappears, and the nervous symptoms improve. The body weight increases. Cure is exceptional, but a satisfactory state of health is obtained.

PITUITARY TUMORS.—The treatment is indicated and gives good and lasting results at the start, in the stage of hyperplastic lesions and over-functioning of the pituitary.

It is contraindicated in the stage of decline (functional insufficiency of the organ; stage of retrogressive and destructive changes).

THYMUS HYPERTROPHY.—Involution of the gland under the rays is here extremely rapid (sometimes in a few hours). Recovery is lasting. The treatment can be employed even in nurslings. The serious respiratory symptoms pass off with the first treatment.

Diseases of the Skin and its Appendages.—The X-ray is very extensively used in dermatology for a great variety of disorders and with striking results.

TINEA.—The only effective treatment is complete depilation. The latter alone permits of disinfection of the follicle, and the X-ray alone permits of easy and complete depilation.

TINEA CAPITIS.—The hair is shaved off and the skin cleansed with soap and disinfected. The entire head is treated with a series of irradiations, all on the same day. Six hours later an erythema appears, persisting twenty-four to forty-eight hours. The hair begins to drop out on the sixteenth day. Depilation is complete on the twenty-second day. The child can then be considered cured. The hair begins to grow again 2½ months after the depilation and two months more are required for complete restoration.

SYCOSIS.—Same procedure; the early reaction is more intense and is often accompanied by itching and swelling.

BLEPHARITIS CILIARIS.—The X-ray acts in the same manner as in the tineas, *i.e.*, by causing the infected hairs to drop out.

ANGIOMA.—The X-ray and radium are the remedial agencies of choice in this condition. If the angioma is superficial, *elevated*, pigmented, or deep without skin change, a cure is obtained without scarring. In the case of the flat superficial angioma or portwine mark, cure is more difficult and is obtained only at the cost of a slight X-ray dermatitis.

KELOID AND KELOID SCARS.—Successful results are constant in recent keloid scars. The tumor subsides, the skin softens, and recurrence does not take place.

ACNE.—Acne rosacea and especially acne keloid are strikingly improved or cured by two or three exposures at intervals of one or two weeks.

Pustular acne is eliminated by the same procedure, through atrophy of the glands. The treatment involves depilation, which is merely temporary.

PSORIASIS.—Each patch is given separate treatment. A single exposure is generally sufficient for each patch, which is cleaned off in less than a week. The itching stops within twenty-four hours. The more recent the appearance of the patch, the more quickly recovery takes place. The duration of the treatment depends on the number of patches and is subject to the appearance of fresh patches.

VARICOSE ULCER.—X-ray treatment acts strongly in this condition. The atonic ulcer heals after a very few exposures. A single treatment may be sufficient to improve the appearance of the ulcer.

The Symptom, Pain.—The X-rays produce an analgesic effect. They act quickly and regularly in itching skin disorders. The action is often less prompt and more irregular, however, in neuralgias, including trigeminal and brachial plexus neuralgia, sciatica, etc.

The irradiation is carried out either over the painful area or over the points of emergence of the spinal roots of the affected nerve. Concerning the manner in which the X-ray treatment acts very little is known. The pain sometimes stops suddenly in the night following one of the exposures. Three to six exposures are required.

X-ray therapy may be recommended with some confidence in neuritis, including neuritis of large trunks such as the sciatic; in painful neuroma, painful stump, and in scars rendered painful through irritation of the nerve terminals.

In the most obstinate of the neuralgias, *viz.*, trifacial neuralgia, when it is a true neuralgia, with Valleix's points and disturbances of objective sensibility, the X-ray possesses a powerful action, too often overlooked. It should be applied previous to the injection of alcohol, being less effective after such an injection has been made. A highly penetrating radiation should be employed, and 70 per cent. of the erythema dose applied over the region of the Gasserian ganglion. The irradiation is generally divided over three fields—temporal, frontal, and maxillo-facial. This technic permits of curing permanently in a few hours the mild forms of trigeminal neuralgia. The severe forms are sometimes only temporarily relieved, but a second irradiation

may be given at the end of four to six weeks; this nearly always results in a definite cure.

In sciatica the X-ray likewise affords some highly successful results. It should be resorted to in the chronic forms which are not symptomatic and have not yielded to ordinary treatments. The region of the nerve-roots and likewise that of the buttock along the course of the nerve are the parts irradiated.

Finally, it should not be overlooked in prescribing X-ray treatment for cancer that the painful manifestations (pressure pain or pain from terminal neuritis) are remarkably relieved by it.

X-RAY TREATMENT IS SERVICEABLE IN THE FOLLOWING CONDITIONS:

TUMORS.	TUBERCULOUS CONDITIONS.	LEUKEMIA. LYMPHATIC ENLARGEMENTS. SPLENOMEGALY.	DISEASES OF THE ENDOCRIN ORGANS.	DISEASES OF THE SKIN AND ITS APPENDAGES.	NERVOUS DISEASES.	THE SYMPTOM: PAIN.
It is an Important Therapeutic Factor in:						
Malignant. **Of the skin:** Epithelioma. Rodent ulcer. Melanosarcoma. Mycosis fungoides. **Cancer of the breast.** **Sarcoma.** Lymphosarcoma of the neck or mediastinum. **Benign.** **Uterine myoma.** Keloid. Angioma.	**Cutaneous.** Lupus. **Lymphatic.** Tuberculous adenitis. Adenitis with ulcerations and sinuses. **Articular.** Tibiotarsal. Knee. Wrist, etc. **Osseous.** Spina ventosa. Osteitis of foot, tibia, wrist, etc.	**Leukemia,** myelogenous, lymphatic, aleukemic. Aleukemic splenomegaly.	**Thyroid.** Exophthalmic goiter. **Pituitary.** Acromegaly. Giantism. **Thymus.** Hypertrophy.	**Tineas.** Sycosis. Folliculitis. Blepharitis ciliaris. **Acne.** Pustular or keloid. **Eczema.** Psoriasis. Lichen. **Keloids.** Angioma. Warts.	Syringomyelia. Disseminated sclerosis.	**Neuralgias.** Brachial plexus. Sciatica. Trifacial. In cancer. Painful scars. Painful stump. Pruritus ani, vulvæ, etc.
It is an Alternative Therapeutic Factor in:						
Malignant. **Deep-seated cancers.** Rectum, Uterus, etc. **Cancers of** Tongue. Larynx. **Malignant tumors of the eye:** Glioma. Sarcoma of iris. **Benign.** Certain lipomas. Neuromas.	**Tuberculosis of** testicle, peritoneum, larynx.	Infantile splenic anemia. Banti's disease. Malarial spleen. Pernicious anemia.	**Adrenals.** High pressure syndrome.	Hypertrichosis. Hyperidrosis. Alopecia areata. Itching seborrheic disorders. Ichthyosis. Varicose ulcer. Corns.	Pachymeningitis. Spastic paralysis. Traumatic paralysis. Tabes dorsalis.	**Herpes zoster.** Rheumatic fibrositis.

HELIOTHERAPY.

By A. Lomon, M.D.

Heliotherapy makes use of direct sunlight in the treatment of local or general disorders. The beneficial action of sunlight on the system has been known and appreciated a very long time. The obstacles encountered by the practice of heliotherapy in large cities have retarded the general employment of a form of treatment which exerts a very happy effect in some disease conditions.

There is no doubt that factors other than the sunlight take part in producing the favorable results of heliotherapy. The skin constitutes a very extensive receptive tissue, which is stimulated by heat, by the variations of temperature resulting from air currents and by the evaporation taking place from its surface. The skin, when freed from its protective layer of clothing, regains its rôle in its functions of insensible and actual perspiration, of the regulation of heat interchange, and of defence against cold and heat. The wearing of clothing has taken away from it its rôle of warning and protection. Upon exposure to the sun and air, however, it soon regains these attributes. The reaction to heat and cold becomes more prompt through greater activity of the peripheral circulation and of perspiration. As a result of immediate reactions, a balance is struck between the requirements of the system and its defensive agencies. The reactions are more easily provoked and more rapid, and the means of defence more powerful and certain.

* * *

Nature and Measurement of the Solar Radiations.—We actually perceive only a part of the rays emitted by the sun, *viz.*, those with wave-lengths ranging from 20 μ to 0.3 μ.

From 20 to 0.8μ: infra-red, caloric portion of the solar spectrum	80 per cent. of the total energy.
From 0.8 to 0.4μ: visible, luminous portion	14 " " " " "
" 0.4 to 0.3μ: ultra-violet, chemically active portion	1 " " " " "

The carbon dioxide and water vapor arrest a portion of the infra-red spectrum; the air, and especially the ozone of the upper layers of the atmosphere, arrest a large portion of the ultraviolet.

To measure solar radiation, actinometers may be used, some of which measure the heat rays, others the chemical rays (Campbell's heliograph; Nicholson's actinograph; Vallot's heliothermometer).

Physiologic Effects.—Sunlight activates the movements of living beings both through its action on the integument and through the intermediation of the nervous system.

It acts on the blood, increasing the number of red cells and leukocytes and the hemoglobin percentage. It stimulates lymphocytosis, and exerts directly or indirectly a very distinct bactericidal action. The action of the sun's rays on wounds does not appear to be wholly ascribable to the bactericidal action of the actinic rays. The ultraviolet rays, arrested by the atmosphere, do not reach us, or do so only in a very small amount. The hot portion of the spectrum appears to be the active portion.

Mode of Action of Heliotherapy.—General Action.—A sunbath procures an agreeable sensation of warmth and induces more or less copious perspiration. It is accompanied by a feeling of well-being, or euphoria, which persists for several hours. It is both soothing and stimulating. It activates metabolic changes, and oxygenation is improved.

The appetite becomes insistent, bodily strength is increased, and there is a gain in weight, while at the same time a reduction of nervous irritability and quiet of the entire organism are witnessed. Some persons experience at first, or when the sun is too hot and exposure to it too prolonged, giddiness, headache and excitement. In the stage of habituation, however, the patient can withstand exposure of his whole body, however intense the sun's rays may be. Protection of the head may be availed of, at least in the first few weeks of the treatment.

Local Action.—Sunlight exerts an analgesic and resolvent action. The swelling and infiltration in osteitis and osteoarthritis recede under its influence. Sinuses are dried up through an exaggerated influx of pus-producing cells and the drainage thereof, as well as by an increase of phagocytosis. The cicatrizing action of the measure is unquestionable. The discharge becomes serous in character, diminishes in amount, and the inflammation in the vicinity disappears. The ulcerated surface becomes progressively smaller. The resulting scar is soft.

On the healthy skin there is noted from the start an erythema, followed by desquamation if the initial exposure has been too protracted, then by pigmentation.

Mode of Application of Heliotherapy.—Heliotherapy comprises the direct action of the sun's rays and the action of diffused sunlight. It can be made general by exposure of the unclothed subject in the sun (sunbath) or to diffused light (airbath).

It may also be applied locally, *e.g.*, over the affected area in tuberculosis of the bones or joints. In this case only the direct sunlight is used. It may even be concentrated by means of lenses (Artault de Vevey).

A sunbath should as much as possible be taken in the open air and with the skin exposed. Only in the case of patients who require coddling should the isolation be carried out in a glass enclosure. The entire surface of the body should, furthermore, be exposed, if possible. The heliotherapy must, however, be carried out progressively. There is an initial period of preparation and adaptation lasting from one to three weeks. It is best to expose the patient's entire body to the sun from the start. The duration of the first treatment is five minutes. The time is then increased so as to reach an exposure of one-half hour at the end of a week. Two exposures daily should be instituted at this time, so as to reach gradually a total exposure of three hours a day.

The most favorable time of the day is between 10 a. m. and 3 p. m., but this depends on the season, the temperature and the weather. Exposures are advantageous from 8 a. m. to 6 p. m. in the summer, and from 10 a. m. to 3 p. m. in the winter. The sunlight possesses the same curative properties in winter as in summer, but the useful effect of the rays is naturally proportionate to their intensity, and the exposures ought to be longer in winter than in summer—a condition seldom obtainable.

If the condition of the patient permits, it is well to conclude the sunbath with a cold ablution, or better, actual immersion in cold water. The subject then dons his clothes at once and warms himself in the sun or by walking.

ARTIFICIAL HELIOTHERAPY—THE ULTRA-VIOLET RAYS.

The former term is occasionally applied to the treatment of certain conditions by artificial forms of light. It appears to the writer incorrect. The procedure carried out is really either *phototherapy* or *thermotherapy,* according to the source of the light.

The term *Finsen therapy* is reserved, as is well known, for the treatment by a very special technic of certain skin conditions, especially lupus, by the rays from powerful arc lights. The source of light under these circumstances is very rich in infra-red rays.

INDICATIONS FOR HELIOTHERAPY (*Lomon*).

Tuberculosis of bones or joints, or peri-articular tuberculous disease, whether "open" or "closed." Superficial osteitis. Osteo-arthritis. Spina ventosa. White swellings. Coxalgia and Pott's disease.	**Pulmonary tuberculosis.** (The treatment should be carefully watched in patients with a tendency to lung congestion and is contraindicated in cases with hemoptysis or with acute pleural lesions.) Tuberculosis of sluggish type. Tuberculosis of fibroid type. Tuberculosis following pleurisy. Chronic bronchitis.
Tuberculosis of the lymph-glands. Subcutaneous lymphatic enlargements. Cervical adenitis. Mediastinal adenitis.	
Certain forms of genito-urinary tuberculosis. Orchitis and epididymitis. Tuberculous cystitis. Salpingitis.	**Sluggish wounds without a tendency to heal.** Varicose ulcers. Burns. Wounds that have been suppurating a long time.
Tuberculosis of the peritoneum and intestine. Caseous peritonitis. Peritonitis with ascites. Tuberculous enteritis.	
Tuberculous skin conditions. Some forms of lupus. **Tuberculosis of the larynx.**	**Skin diseases.** Some forms of lupus. Eczema, dry or moist. Prurigo. Superficial cancerous growths.

With the mercury vapor lamps, such as the Kromayer lamp, and those of Cooper-Hewitt and of Westinghouse, the heat spectrum is greatly reduced and there are obtained radiations very rich in blue, violet and ultra-violet, especially if the lamp is of quartz or uviol. The ultra-violet rays have no depth action; the epidermis arrests them, so that their sterilizing and bactericidal action is wholly superficial, whereas the radiations of the visible spectrum and the heat rays pass through rather thick layers of tissue.

In certain skin lesions, such as lupus, psoriasis and epithelioma, benefit is derived from the sterilizing, counterirritant and even caustic action of the light from ultra-violet lamps.

A light as intense as possible, obtained with mercury vapor lamps of several thousand candlepower, but from which the ultraviolet rays are filtered out by suitable glass screens, permits of effective treatment of osseous or peri-articular tuberculous conditions. As in true heliotherapy, the region under treatment must be exposed gradually and progressively. There would appear to be every reason to carry out very extensive irradiations, even over the whole body, local treatments being indicated only in cases where circumscribed effects of irritation or destruction are desired.

The contraindications are those of natural heliotherapy—renal, pulmonary, or vascular lesions.

Very soon the patient experiences a sensation of well being; his appetite improves, he sleeps more soundly, and his weight increases rapidly; the number of red blood corpuscles increases while that of the white cells decreases.

As for the effects produced on the local lesions, it may be well to mention first of all the very favorable results obtained in *tuberculous peritonitis.* Results are less rapid in *tuberculous synovitis* than in peritonitis.

In *tuberculous adenitis,* two types of cases must be considered, *viz.,* those in which the lymph-nodes are not softened, and those with softened nodes and sinuses. The first group become very quickly softened, and have to be punctured; it seems that after puncture a cure is obtained more quickly. In the forms with sinuses, the characteristic result is diminution of the oozing with a spreading-out of the fungous outgrowths, which become fibrosed and cease to bleed.

In *tuberculous orchi-epididymitis,* the hydrocele must be evacuated by puncture before the treatment. The results are particularly good in the cases with softening and sinus formation.

Treatment with the ultra-violet rays has a quite remarkable action on *suppurating fistulous tracts of long standing* and on *non-tuberculous ulcerating wounds.*

The ultra-violet rays have thus brought into the therapeutics of tuberculous affections an ally that must not be neglected. The treatment calls for experience and technical skill. If it be applied without discrimination, there may be produced local and general congestive conditions which, in certain cases, may "whip up" torpid lesions and aggravate the situation.

Heliotherapy is an obvious adjunct of climatic treatment.

Psychic Agencies.

PSYCHOTHERAPY.

"Psychotherapy is the treatment of diseases by psychic means, *i.e.*, by persuasion, emotion, suggestion, distraction, education, faith and sermonizing; in short, by thought and all its appurtenances" (Grasset). Essentially, it consists of treatment by the mind or by psychic means.

Grasset recognizes an "inferior psychotherapy" and a "superior psychotherapy."

1. **Inferior psychotherapy,** practically indistinguishable from **suggestive therapeutics** and in some degree including the various forms of **hypnotism,** far from appealing to the will-power, personality, intelligence and reasoning power of the subject, calls into play chiefly a subconscious automatism, and enhances and aggravates the mental dissociation of neurotic individuals subjected to it. Its risk and contraindications are many, and all psychiatrists recognize and proclaim them. Its cardinal indication is afforded by certain restricted and persistent localizations (contractures, paralyses, etc.) of the neuroses, and especially of hysteria.

Janet defines suggestion as a procedure which "consists in provoking artificially, in the form of an impulse, the operation of a tendency which the subject is unable to obtain in the form of a personal act of the will. We simply substitute immediate assent for assent based on reflection; we call upon the inferior activities, upon automatism."

The curative results obtained are practically limited to cases of hysteria. The aggregate yield of the treatment is very low. Out of 3800 cases treated, Janet obtained only 250 recoveries, or less than 7 per cent.

A distinction has been and is still being made between suggestion during the waking state, which very often practically amounts to persuasion, and suggestion in the state of induced sleep or hypnosis, which constitutes the at one time popular procedure of hypnotism.

Suggestion in the waking state, which we all apply and to which we are all more or less subject, consciously or unconsciously, varies ac-

cording to the suggestibility of the individual, the persuasive power of the therapeutist, and the hold which the latter has on his patient. Its influence may be enormous, and its results may border on the miraculous. There is no doubt that many of the Christian Science and miracle cures are dependent upon it. Its general technic can be condensed into the following three propositions:

1. *Obtain the greatest possible authority over the subject.* It is very hard to define the factors in this personal "hold," which, according to the patients and therapeutists concerned, may consist of intellectual superiority, moral elevation and technical virtuosity or, at the other extreme, deceit, obfustication and charlatanry.

2. Take advantage of it to make a *searching analysis of the patient's psychophysiologic miseries.*

3. By persuasion, *instil a mental tendency to inhibit the symptomatic manifestations,* where the subject would have been unable by personal will-power alone to develop such a tendency.

As for *suggestion in the state of sleep or hypnotism,* it differs from the preceding method in that the subject is first placed by various means (rotating mirror, magnetic passes, suggestion in the waking state, hypnotics, etc.) in a state of somnambulistic sleep which makes his suggestibility very much greater; suggestion is then brought into play in the form of imperative directions.

There is no doubt that hypnotism frequently exhibits the appearances of a product of simulation (H. Meige), is ordinarily indistinguishable from hysteria itself (Deny), and is but a manifestation of mythomania (Dupré). Yet it seems one must conclude, with Babinski, that "the actual existence of a condition which one may call **hypnotic sleep,** notably different from all the other kinds of sleep and easily susceptible to simulation, appears very likely."

Babinski, to whom an appeal on this question is always in order, concludes that "hypnotism neither creates nor increases suggestibility, which in consequence appears devoid of object. In the past, to be sure, a large number of hysterical cases have been cured after being hypnotized; but the cure was not the consequence of the hypnotism, but arose from the fact that the patients were suggestible or able to respond to the influence of persuasion. They would have been relieved of their illness just as well by psychotherapeutic procedures applied in the waking state. . . . Yet a few hysterical patients, after having tried most of the methods of treatment in vain, suggest to themselves that hypnotism alone might make them well; under these conditions, hypnotism becomes altogether legitimate" (Babinski).

2. **Superior psychotherapy** sets down as its object and presents as its indication "the cultivation, development, enhancement and perfection of the will, of self-control, of the mental unity of the ego, and of the normal and complete personality."

It constitutes the treatment of choice in the psychoneuroses, *i.e.*, of those conditions characterised by a certain degree of mental debility or disintegration, of psychic instability, and of nervous incoördination with impulsiveness, psychasthenia, etc.

Superior psychotherapy may be applied by direct or by indirect action.

"In the cases of relatively slight severity, one may exert psychically a *direct action* on the mental phenomena of the patient: Thought, sensation and emotion. The action on the patient is effected by conversation, reasoning and demonstration that a thing which he believed impossible is perfectly feasible for him. The patient's reading matter, diversions, occupations and social relationships are selected for him. . . .

"There are many cases, however, in which this classic and well-known method fails completely: The morbid thought, sensation or emotion are not influenced by the patient's will. The thought, sensation or emotion imposes itself upon him.

"In these patients one can exert an *indirect psychic action.*

"This indirect action is based on the following principles:

"1. An ordinary involuntary thought, sensation, emotion or mental state can be brought into being by having the patient carry out some act conforming to this thought, sensation or emotion.

"2. When one wishes to drive in, develop, concentrate, firmly fix and fortify a thought or sensation, one should voluntarily carry out all the acts which conform to this mental state, are derived from it or are applicable to it. Thus, attention should be paid to the thought and it should be wilfully analyzed, discussed, reasoned out, talked of, written of, and conformed to in all acts, and one's whole voluntary life should be subjected to it as much as possible.

"Conversely, if one wishes to weaken, diminish, blot out a thought or sensation and cause it to disappear, one should do wilfully the converse of that which has just been described, *i.e.*, one should perform no act relating to this mental state, never talk of it, never write of it, never discuss it, never subject any phase of one's life to it, treat it with contempt, attach no importance to it, and behave always and everywhere as if this mental state did not exist.

"In brief, these two principles are summarized in this sentence of Payot's: 'I have power over my thoughts only because I am master of my muscles.'

"One sees thus how a whole system of clinical psychotherapy can be founded on these principles." (Grasset: *Thérapeutique générale,* Vol. II, Médication du psychisme, No. 853).

This species of mental orthopedics is extremely captivating and at times of surprising efficacy; generally, however, it is very disappointing; this is because, to be effective, it requires a combination of three factors which is very seldom present: 1. An appreciable psychic reserve power in the patient, or rather, a mental plasticity which will enable him to break with vicious mental habits of long standing and replace them with new psychophysiologic associations. 2. His co-operation, good will and mental effort in the desired direction. 3. Mastery on the part of the therapeutist, which will give him an unquestionable hold on his patient.

* * *

Apart from all idealistic considerations, the close symbiosis between the physical and the mental—to use Bichat's own words—sets up an actual reversible cycle which enables a skilful psychotherapeutist to influence at will an abnormal mental state by purely physical practices, and *vice versa.*

On this is based an entire **elementary system of psychotherapy,** easily applied in current practice, and with which every practitioner should be familiar.

Any one can carry out on occasion a series of experiments which will afford a clear demonstration of the essential features of this method.

Some fortuitous circumstance, let us say, arouses in me a state of "anger." "A tumultuous movement of the irritated spirit," according to the dictionaries; a paroxysmal morbid state, we shall call it, in which the clinician will readily recognize two distinct features: A psychic element, consisting of a condition of irritation or fury, which is precisely that of "anger," often accompanied by disturbances of judgment; a somatic element, manifested in very many ways, and usually characterized, in the ordinary forms of anger, by an "irritated" facial expression, a verbal outburst at a rapid rate and high pitch, brusque and disorderly movements, heightened muscular tension with a tendency to violent outbursts of motor activity, protrusion of the eyes, precipitate heart-action, tremor, various vasomotor manifestations, etc.

Let a happily conceived answer on the part of the interlocutor, an opportune diversion or a really convincing argument appease my irritation, and as a result the somatic manifestations disappear, the features relax, the speech returns to its customary rate and pitch, muscular tension is attenuated, the heart slows down, and the tremor subsides.

If, on the other hand, during the paroxysm I have sufficient presence of mind and self-control to "smile" at myself by looking into a mirror, to talk slowly, in a low tone and deliberately, and to walk a few steps at a moderate rate, my anger cools down, my irritation subsides, while at the same time the phenomena of a sympathetic order, *viz.*, tachycardia, heart constriction, and vasomotor disturbances, become less and then pass off.

This method is one of very general application.

Overwork, repeated misunderstandings, the "thousand pinpricks" of a strenuous life have put me "beside myself;" I am "enervated;" my responses are exaggerated and disorderly. . . . A most definite somatic evidence accompanies this abnormal condition: My handwriting is becoming hasty, irregular, disorderly, unfinished, almost illegible.

Let me retain enough presence of mind and will-power to compel my hand to move more slowly, regularly and completely; let me succeed in writing a dozen lines, slowly and deliberately, of complete, regular script, with the required punctuation, and my "spirit" will relax along with my handwriting.

The applications of this type of discipline are innumerable:

Because of overwork, friction or bad news, a man is seized with precordial discomfort, with the associated sensation of chest constriction, constrictive or vaso-constrictor radiations along one arm, and pallor of the hands. Let him immerse his forearms in a basin of very hot water, meanwhile compelling himself to take regular, deep breaths, and the natural color of the skin will return through vasodilation and the precordial discomfort lessen or disappear.

This method, which is one of very general application, is founded on the procedure of judiciously bringing into play the physiologic roots of sensibility.

It consists essentially in subjecting the individual to a form of physical discipline wherein he is made to carry out the gestures, assume the attitudes and perform the acts that are antagonistic to the usual somatic manifestations of the emotional state which one is trying to eliminate.

As the foundation of all psychotherapy there must be a searching *psychoanalysis.*

Here we are taking up a rather delicate question, which some will deem out-of-place in a work on therapeutics. Only after due consideration of the *"ne sutor ultra crepidam"* of the master painter of old and the expression "Let us not force our talent" of the wise fabulist did I decide to go into it, deliberately, whatever risk may be run in doing so. This is, to my mind, the loftiest division of therapeutics; none is of greater importance.

Disease proves, when its causes are analyzed with care and without preconceived notions, to be ordinarily the result of some wrongdoing or imprudent act which is but a variety of it, or of some mistake or piece of ignorance which is merely a factor in it. As a matter of fact, no wrongdoing or mistake may have been committed by the patient, but the patient nevertheless has to suffer from the resulting disease, consequent upon some wrong-doing or mistake, whether committed by himself (hepatic cirrhosis following alcoholic abuse), or by his father (congenital syphilis the result of infection of the father), or by some other individual (trauma resulting from the actions of a drunken motorman or a piece of carelessness), or by the family as a whole (gout consequent upon familial and ritual alimentary excesses), or through poor occupational conditions imposed on the worker (tuberculosis the result of poor working conditions), or by society itself (various forms of disease and degeneration the result of poor housing conditions, street solicitations, alcoholism and collective hygienic deficiencies which might be avoided by appropriate measures). Let this inquiry be carefully followed out and it will be seen that very few diseases, if any, escape from this grouping—whether one be dealing with hydatid disease following the ingestion of insufficiently washed salad, or with malaria due to the bite of mosquitoes produced in a stagnant pool which wise authorities would have caused to disappear, or with pleurisy brought on by exposure in a woman wearing excessively scanty clothing, or with an obstinate facial neuralgia following untreated dental caries—without mentioning all the inherited constitutional taints or diatheses attributable to alcoholism, syphilis, unrestrained neurotic states, laziness, ignorance or vice in the patient's antecedents.

It should be noted, furthermore, that some of these harmful acts and errors are morally of a most laudable nature. A mother, for example, will exhaust herself and develop tuberculosis in the attempt to nurse her child, in spite of all advice to desist; a father will overwork and ruin his health in order to procure happiness and comfort

for his family; a person will develop acute rheumatism on account of having jumped into the water to save someone who had just cast himself into it. Here, the mother, father, and life-saver are worthy of all praise and have set an admirable example of self-sacrifice.

But the mother is nonetheless the victim of an error (that of having *mistakenly* believed that she could nurse her child); the father, either of social conditions which compel him to perform dangerous work in order to support his family, or of exaggerated notions he has formed on the subject of that which constitutes happiness and comfort, or of the selfishness and blindness of his dependents; the life-saver, of the would-be suicide who should not have thrown himself into the water, and the suicide himself, of the mistakes and faulty acts which drove him to the attempt at self-destruction, etc.

If the following propositions are obvious to us, *viz.:*

1. That no effect is without its cause.

2. That the commonest (and probably universal) underlying causes of disease are, a wrong act (or an imprudent one) or an error (or an act the result of ignorance), either by the patient or by some other individual or social group.

Then, there is no doubt that our duty as therapeutists compels us to seek and combat these causes: Wrong acts, imprudent acts, acts the result of ignorance or other mistaken acts, both in others and in ourselves.

No harm results if the specialist confines himself solely to the application of the technical procedure with which he is identified; or if the surgeon excising a diseased organ, or the radiotherapeutist undertaking by systematically applied exposures to cure a superficial neoplasm or exophthalmic goiter, or the ophthalmologist operating on a cataract, or the dermatologist treating a case of alopecia, should pay only rather distant attention to the psychotherapeutic task.

But what physician worthy of the name would dare to maintain that the same is true in his field, especially in the chronic cases, and more particularly still in respect of the countless hordes of anxious neurotics with phobias, the unbalanced, the psychoneurotics, the pseudo-dyspeptics, the pseudo-cardiacs, the pseudo-asthmatics, etc., whose condition is in most instances exclusively the result of some psychic fault or error—pride, avarice, incontinence, envy, overeating, anger, laziness, selfishness or ignorance?

There are diseases due to laziness, anger, overeating and incontinence. Some forms of neurasthenia constitute merely the terrible reckoning for selfishness, if, indeed, they are not simply a form of it.

A pseudo-cardiac case, for example, anxious and complaining of precordial discomfort and palpitations, is afflicted with the disease due to vanity and is merely suffering from the incessant punctures which reality is making in his pretensions; a neurasthenic and pseudo-dyspeptic, flatulent and belching, is a self-centered person absorbed in the contemplation of his visceral universe and in whom an attack of indigestion has directed all his attention to his digestive processes; an asthenic, pseudo-hepatic individual, bilious and out-of-sorts, is an envious person to whom the tranquillity, serenity or prosperity of others is intolerable.

Bromides and valerian will be useful in the first patient; alkalies and absorbent powders in the second; sodium sulphate and calomel in the third, and hydrotherapy in all. But the first one will be cured only if he incorporates in his substance the aphorism of the Hebrew philosopher to the effect that "all is vanity;" the second, if he succeeds in diverting his mind by becoming interested in something other than his borborygmi, and the third, when he acquires the ability to participate in the happiness of others. Should we not, then, help our patients as much as lies within our power and without concealing from ourselves the difficulty of the undertaking? These mental tendencies—vanity, selfishness, envy, etc.—come very close to being actual diseases, too often incurable. "Chase away that which is natural, and it will come back on the run. The dog always returns to his vomit." This aphorism is, unfortunately, only too correct; there are enough exceptions to it, however, to make it unwise to dwell on it too long.

The greatest objection that may be raised is one to the effect that the end in view is too often beyond our means of attaining it, and especially, that such a conception involves some risk of bringing into ridicule the one who applies it. I am honored in having among my friends many colleagues who, in all probability without themselves being aware of it—and this is the best way—are regularly applying this species of mental orthopedics or psychic dietetics in their every-day work. One of them, who is the mayor of his town, a short distance from Paris, has for over forty years been exerting the profoundest sort of a moral influence over his constituent patients whose gratitude—an uncommon article—has brought him marked honor. Another, whose powerful influence has been exerted not only on his patients but also on all medical men who have been fortunate enough to be in contact with him was himself, he told me, subject in his youth to ridiculous fits of anger. Fernet has been bold enough to devote an entire book to the "hygienic virtues"—sobriety, assiduity, activity, education of the body functions, chastity and a regulated life.

Lastly, the aphorism "*medice cura te ipsum,*" may too easily be set loose. To my mind, the objection referred to is not well-founded. Has a physician who happened to be tuberculous or suffering from heart disease or ankylosis ever been disqualified from treating cases of tuberculosis, heart conditions or joint disease? Why should it be otherwise in the case of a medical man subject, like all other mortals, to the majority of the psychic deficiencies above enumerated? Is a physician who overeats and is suffering from lithiasis disqualified from emphasizing the dangers of these things, even though he is afflicted with them but cannot find in his convictions and will-power the strength necessary to effect his own cure? Should a mercurial and choleric physician become an apologist of irritability of disposition and anger, or combat them in other persons, even if he is unable to gain mastery over himself, etc.?

As for the mode of application of this mental orthopedics, it cannot be systematized. It is felt or guessed and hardly expressed, and can scarcely be learned. What has already been said of it is sufficient.

* * *

FREUD'S PSYCHOANALYSIS.—A few years before the World War, Freud, a Viennese physician, proposed a therapeutic method which caused a deal of talk, especially abroad, and which is founded on psychoanalysis.

Psychoanalysis consists of seeking out the origin of a psychoneurosis or delusional idea in some former train of thought *submerged* below distinct consciousness; in an emotion which was not able at the time to give itself free expression, or in some strong desire which could not be immediately satisfied.

But what is special and, especially, open to criticism in Freud's system is that he ascribes all neuroses and psychoses to sexual emotions; to the repression of more or less perverse genital longings, to physico-sexual non-satisfaction.

The first step in the application of the method consists, accordingly, in making a diagnosis of the *repressed emotion,* the recollection of which seems to have been effaced and which the patient cannot spontaneously bring to light. And yet, although hidden in some remote recess of the memory, this repressed emotion so dominates the personality of the individual that it may, even twenty years later, cause more or less serious psychic disturbances.

It becomes thus necessary to investigate the patient's *subconscious mind,* not by the process of hypnotism, but by an *analysis of the*

ordinary acts of his *daily life, through analysis of the dreams,* of word confusion, of forgotten things, etc.

When this *"complex"* has been discovered, it is then required, in a second stage, to show to the patient the actual cause of his trouble, and the doing so effects a cure.

Successful results have unquestionably been obtained—in special cases, however, in which the etiology was actually sexual. Essentially, in these cases, psychoanalysis did not act any differently than the other psychotherapeutic methods, *i.e.,* bringing suggestibility into play.

The error residing in this method is to refer the origin of all psychoneuroses to sexuality, whereas such instances are really the exception. Very many persons with asthenia, anxiety, or hysteria have always had a normal sexual life and satisfied genital appetites, and the origin of their troubles must be sought in disappointed ambitions, the blows sustained in the struggle for life, the powerful emotions caused by war or other conditions, changes in circumstances, etc.

The danger of the method, for it is far from being without drawbacks, lies in arousing ideas of unworthiness in latent self-accusers, in complicating hysterical symptoms, in exciting persons previously calm and quiet, etc.

"I consider," says Prof. Guillain, "that the treatment of the psychoneuroses proposed by Dejerine (a treatment directed especially to the emotional sphere of the patient) was greatly superior in its results to the modern therapeutic procedures of psychoanalysis, which have acquired unwarranted vogue and are often dangerous for the patients through their reckless application."

PART II.

COMMONLY EMPLOYED THERAPEUTIC PROCEDURES.

(*WRITTEN WITH THE COLLABORATION OF P. DESFOSSES, M.D.*)

Commonly Applied Therapeutic Procedures.

(*Written with the collaboration of* P. DESFOSSES, M.D.)

GENERAL CONSIDERATIONS.

Medical therapeutics involves the continuous application of various more or less commonly practised procedures. Some of these have already been dealt with in a systematic, brief, but substantial review comprised in the section on *Physical Agencies* in Part I of this work.

Others, for the most part procedures of minor or major surgery—in short, *manual procedures*—constitute the subject-matter of the present Part II, on *Therapeutic Procedures.*

In this portion of the work the really commonly used procedures of treatment, which every practitioner must be able to carry out himself, are dealt with in a concise, but sufficiently complete, presentation. The actually surgical procedures have only briefly been mentioned, with some accompanying demonstrative illustrations. Under these conditions, indeed, the physician must turn over the treatment to the surgeon; but it is he who should formulate the indications, and this he cannot do intelligently unless he has an exact idea of the nature and significance of the operative intervention recommended.

Necessary additional data on technic will, as a matter of fact, be found presented at various points in this work.

I

PROCEDURES RELATING TO THE SKIN SURFACE.

I.—URTICATION.

Urtication, properly so called, was carried out by whipping a portion of the body with nettles (*Urtica urens*). Blatin proposed that urtication be secured by means of an ointment consisting of lard in which had been incorporated by simple admixture the barbed, silky hairs of the cowhage (*Dolichos* or *Mucuna pruriens*) to the amount of 0.5 gram (7½ grains) in 30 grams (1 ounce) of lard. *Pencils* coated with *croton oil* or with *extract of capsicum* have been used to induce local heat of the skin, persisting for several hours and subsiding gradually, and a hyperemia of varying degree. *Counterirritant wheels,* to be drawn over the skin, and various forms of *electric brushes* have also been devised.

Moxa.—This term is applied to a small cylinder of combustible material, made to burn slowly in contact with the skin so as to cause a destruction of tissue involving a portion or the entire thickness of the skin; the moxa is a most powerfully acting counterirritant.

II.—BLISTERING.

Vesication or blistering consists of an irritation of the skin sufficiently marked to lead to the appearance of blisters, *i.e.,* cavities beneath the epidermis filled with serous fluid.

Indications and Contraindications.—Blistering has been much used in the past in pneumonia, pleurisy, tuberculosis, spinal or meningeal disorders and neuralgia. Blisters are sometimes termed *fly* blisters when their action is intended to be only temporary, and *permanent* blisters if the irritation is to be kept up by means of irritating ointments.

Nephritis, albuminuria and glycosuria are the contraindications relating to the use of blisters.

Materials Required.—To induce blister-formation one may use, in the first place, *heat.* A metallic hammer, heated in boiling water for a minute and applied over the skin for three or four seconds, will produce a blister.

To blister with *ammonia*, a piece of cloth may be folded several times into a compress, moistened with pure ammonia, and applied over the skin; rapid blistering results. Or, a piece of tinder (surgeon's agaric) of the size of the required blister may be impregnated with ammonia, applied to the skin and covered with a piece of diachylon plaster; the desired blistering is obtained in a few minutes. The device generally employed, however, is the *cantharidal plaster* [*Emplastrum cantharidis*, U. S. P.].

One form of application of the fly blister ("mouche de Milan") consists in the use of a round piece of black taffeta, 4 centimeters (1½ inches) in diameter, covered with a cantharidal paste somewhat different from that used on the plaster. [The composition of the paste is cantharides, yellow wax and Burgundy pitch, of each 50 parts; Venice turpentine, 10 parts, and oils of lavender and thyme, of each 1 part.] These blisters can be left on longer than the ordinary blistering agents.

Preliminary Preparation.—Before the application of a blistering agent the area should be cleansed with warm water and alcohol.

Technic.—The plaster, cut to the proper size—4 or 5 centimeters (1½ or 2 inches)—is first dusted with camphor and slightly warmed. It is kept in contact with the skin by means of two crossed adhesive strips covered with a towel and a bandage. It is allowed to stay on an average of two hours in children, three to four hours in women, and six to eight hours in men. When the blistering produced seems sufficient, the plaster is gently removed, care being taken not to tear the epidermis; small openings at the dependent parts of the blisters are made with sterile scissors, and a dry aseptic gauze compress and absorbent cotton are applied and allowed to remain until healing is complete.

The blister thus produced is a temporary blister, but when it disappears a discolored spot often remains persistently at the area of application.

Untoward Results.—Cantharis, aside from its vesicant action, exerts a marked irritant action on the genito-urinary organs; the admonition to dust the active surface of the blister with camphor is for the purpose of obviating cystitis.

In children, in whom the skin is very sensitive and blistering may be followed by interminable suppuration, blisters should be used only with great circumspection.

After-care.—The utmost cleanliness is advisable in the removal of the blistering agent. Aseptic dressings are required until the irritation has disappeared.

III.—SCARIFICATION.

Scarification is a procedure which consists in making in a given surface a series of incisions extending only through the superficial layers of the skin. In internal medicine, scarification is used for the purpose of local blood-letting. In dermatology, the object of scarification is to divide or lacerate with small incisions a morbid tissue in order to favor its normal cicatrization.

Indications.—In dermatologic practice scarification is employed chiefly in lupus, acne rosacea, keloids and some vicious scars. Scarification as a means of local blood-letting was much used by the ancients; at the present time, however, this method of treatment has practically become obsolete, except in wet cupping.

Instruments.—Scarification can be carried out with the point of a lancet or scalpel or the cutting edge of a razor. In dermatology special devices known as scarifiers are used. One of the most commonly used scarifiers consists of a narrow blade ending in a triangle.

Preliminary Preparation.—Previous to scarification the area to be dealt with should be cleansed with warm water and alcohol.

Technic.—In practising scarification the skin should be carefully placed on a stretch with the left hand. The right hand is steadied against the patient's skin surface with the ring and little fingers and, holding the scarifier like a pen, with a quick motion makes in the skin a series of parallel incisions, to be at once crossed at right angles by another series. The motion of the instrument should be imparted to it wholly by the hand, without participation of the elbow or of the shoulder.

After-care.—The scarification is followed by bleeding, which is ordinarily of little moment; the simplest form of dressing, such as a little gauze or absorbent cotton, is sufficient to check the oozing.

IV.—CUPPING.

The term *cups* is applied to certain receptacles that are placed over the skin for the purpose of causing hyperemia in the entire area covered by them; to obtain this result, some of the air in the interior of the cup must be withdrawn. When the cup is applied to the unbroken skin, the procedure is known as *dry cupping.* When its application has been preceded by incisions or scarifications of the skin surface, the procedure is termed *wet cupping.*

Indications.—Dry cupping is of benefit in some *neuralgic pains. Pulmonary congestion* in very many of its forms, including that of *influenzal origin,* that of *arteriosclerosis* and that of *nephritis,* often indicates the use of dry cups. The same is true of *congestion of the liver* and *of the spleen.*

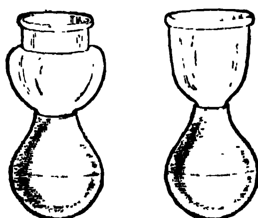


Fig. 112.—Cups with rubber bulbs attached.

Apparatus.—Cupping glasses are species of glass bell-jars having an outlet smaller than the bottom and in which a partial vacuum is established through the combustion of some inflammable substance. Cupping requires little in the way of apparatus—merely a thin rod of wood or metal, a few strands of tow, towelling or cotton, a few

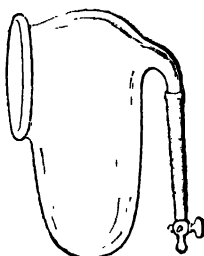


Fig. 113.—Cupping glass especially intended for the breasts.

cubic centimeters of alcohol or coal oil, and the cupping glasses. If no cupping glasses are at hand, an ordinary glass, goblet or small flower-pot can be used.

Preliminary Preparations.—It is well, as a rule, to have the patient lie on the side opposite to that on which the cups are to be applied. Or, he may be merely required to sit down with the body bent forward. In a general way, the patient should be so placed that if a cup happens to become detached it cannot fall on the floor and break.

Technic.—To create a vacuum in the cup, its outlet can be slipped down over the flame of an alcohol lamp, or a small piece of paper, a

bit of cotton or a few strands of lint moistened with alcohol and ignited can be thrown into the bottom of the cup. Instead of these, one may use a little cotton or tow at the end of a small rod or forceps, making a little torch. The cup or receptacle from which the air is to be exhausted is slipped down over the ignited torch for a few seconds; the burning of the alcohol consumes the air in the receptacle.

The cup, being at once applied to the skin, causes a rapid rise of the skin into the interior of the cup. If the flame used is sufficiently



Fig. 114.—**Application of cups.**

small, the edges of the cup will not have become hot and the patient will not be burned, as he is sometimes when more complicated and difficult procedures are employed. Within the cup the skin is drawn up, becomes hyperemic and assumes a purplish hue.

As a rule, the cup is allowed to remain *in situ* for two or three minutes. To remove it, the skin at one side of it is pressed down with the finger-tip while the other hand tilts the cup to the opposite side and withdraws it. After removal of the cups the skin remains hyperemic and purplish for several hours. It resumes its normal color only after several days' interval.

Untoward Results.—Overheating of the edge of the cup or receptacle is to be avoided; otherwise, the patient may be burned.

V.—WET CUPPING.

Wet cups are those applied over previously scarified areas. The measure has for its purpose to induce local blood-letting.

Indications and Contraindications.—Wet cupping is used in the treatment of conditions of inflammation or congestion. It is frequently employed in *acute bronchitis* and in *chronic bronchitis*. Wet cups constitute the classic procedure in *lumbago*. They also represent a time-honored measure in the treatment of *pneumonia; of pulmonary congestion,* especially in plethoric adults, and in particular of *diaphragmatic pleurisy* when the initial pain in the side is severe. *Acute pericarditis, myocarditis* and *endocarditis* also present indications for the use of wet cups, especially when pain is a marked feature. Wet cupping is likewise availed of occasionally in *congestion of the liver* or *of the spleen* when the patient is not in too greatly weakened a general condition. *Acute nephritis* is also treated with wet cups.

Wet cupping is contraindicated in much debilitated patients, in young children and in hemophilia.

Instruments.—The spring scarifier in common use for wet cupping is not a recent invention; it can be found described in the works of Ambroise Paré. It consists of a box of nickel-plated copper containing from 16 to 24 cutting blades, mounted on an axis. By means of this axial rod the operator is enabled, with the aid of the contained spring, to impart to the cutting blades a very rapid semi-circular motion. The surface of the box coming in contact with skin is provided with slots through which the blades pass out at the very moment in which they are placed in motion. The scarifier should always be strictly clean. It should be cleansed each time after use. The process of cleansing consists in unscrewing the cover and boiling the blades, the axis supporting them and the cover in a solution of sodium borate.

When a scarifier is not available any sharp blade, such as a scalpel or razor, can be used.

Technic.—In using the scarifier the first step is to set it by stretching the spring which actuates the blades. The device is then placed on the skin and pressure on a button abruptly releases the spring, the blades then passing out quickly through the slots in the cover. In doing so they incise the skin so quickly that the pain is hardly noticed.

In performing wet cupping, a dry cup is first applied, the skin beneath becoming red and swollen. The swollen area is next scarified, either with the spring scarifier or with some sharp instrument

such as a scalpel or razor. The blood at once begins to flow in droplets; it is wiped off with a sterile pledget and the cup then reapplied over the same area, after which the blood flows more or less rapidly and partly fills the cupping glass. As soon as the flow stops, the cup is removed and the surface of the wound wiped with a sterile gauze sponge. If removal of a larger amount of blood is desired, the cupping glass is again applied. When the local blood-letting is deemed to have been sufficient, the scarified area is wiped off and a sterile compress kept over it for a few days.

After-care.—After removal of the wet cups a sterile compress or strictly clean cloth should be applied over the affected area.

VI.—BIER'S HYPEREMIA.

Bier's method comprises a number of procedures having in common the purpose of inducing **hyperemia** in the region under treatment. Hyperemia of venous origin is induced by setting up an obstacle (elastic band) to the return flow or by reduction of the atmospheric pressure at some point (aspiration of air from a cup); hyperemia of arterial origin is due to the vasodilatation caused by hot or irritating applications (more especially hot air).

Indications.—Venous stasis hyperemia constitutes, above all, a treatment for acute inflammatory conditions. It has been used in all cases of furuncle, carbuncle, acute abscess, whitlow, lymphangitis, phlegmonous processes, infected wounds, and puerperal mastitis. In acute arthritides of infectious origin its favorable effect on pain permits of early mobilization and thus obviate ankylosis.

Apparatus.—The *constricting band* should be of soft rubber, 6 centimeters (2⅓ inches) wide, and should be long enough to go around the limb five or six times.

The *cups* used by Bier are made in a great variety of shapes and are sometimes of very considerable size; the air is withdrawn by the suction of heavy rubber bulbs or by a suction pump. Some of these devices are planned to hold an entire limb; in such instances the necessary close contact with the tissues is made by means of a cuff of rubber (Figs. 115 and 116).

Technic.—The constricting band should be applied at a level remote from the focus of inflammation—in the case of a suppurative process of the hand, around the arm, and in a foot lesion, around the thigh. It should be tightened just enough merely to slow down the superficial venous circulation, though sufficiently to cause a red, warm edema to appear. This exact amount of constriction is somewhat

difficult to obtain; in trying to secure it, one should depend not on the elasticity of the rubber but merely on its adhesion to the skin. Bier's band does not constrict, but is merely wrapped around the limb; the arterial circulation should not be interfered with and the pulse should remain normal. The band should remain *in situ* for twenty

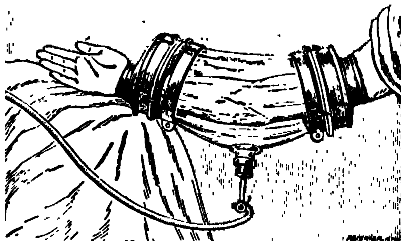


Fig. 115.—Cupping glass for the induction of hyperemia of the elbow (*Bier*).

to twenty-two hours out of the twenty-four in very acute cases, less in conditions in which the infection is less acute, and only a few hours in chronic, subacute, sluggish inflammations and in the declining stages of inflammation.

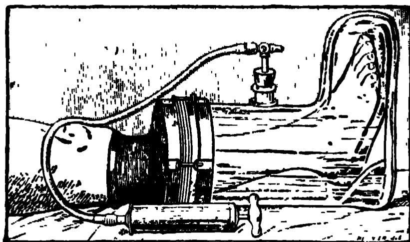


Fig. 116—Cupping glass for the induction of hyperemia of the leg and foot (*Bier*).

The cup is used in the following way: Over the area which is the seat of inflammation, and after a preliminary cleansing, one or more cups are applied, according to the extent of the tissues involved. A thin layer of petrolatum or hydrous wool-fat on the edge of the cup will insure perfect adhesion to the skin. A vacuum is formed in the cup by suction. This vacuum should not be pushed to extremes; it should be proportionate to the extent of the region, the softness of the tissues and the degree of inflammation. The degree of

vacuum is regulated according to the color of the hyperemic tissues, which should become bluish-red, never dark blue nor livid. The cup is allowed to remain for five minutes, then removed. The affected part is then left at rest for three minutes. At the end of this time, the cup is reapplied for five minutes, followed by a rest for the succeeding three minutes, and so on until the end of the treatment, which is continued for forty-five to fifty minutes. One treatment a day is sufficient.

VII.—THE THERMOCAUTERY.

Thermocauterization, like venesection, is one of the oldest therapeutic procedures. Already in the time of Hippocrates its two modes of action, *viz.*, its immediate, caustic, destructive action on the tissues and its remote, counterirritant action in relation to the deep-lying organs, were clearly distinguished.

Indications and Contraindications.—The caustic, destructive action of the thermocautery is the source of numerous indications. It has been employed from olden times in the treatment of venomous wounds, such as the bites of mad dogs and those of venomous snakes, in which the object sought is to destroy the virus *in situ;* such cauterization, as a matter of fact, while very painful, is only of doubtful efficacy.

The point of the thermocautery or galvanocautery, at red heat, may be used to open and destroy certain purulent collections, including phlegmonous acne, furuncles, carbuncles, and cellulitis of the neck; likewise, for the removal of small skin tumors, including warts, molluscum pendulum and papillomas.

The thermocautery may also be used for hemostatic purposes.

The pain element may be combatted with advantage by cauterizations in *neuralgia,* particularly in intercostal neuralgia and sciatica. They accomplish wonders in neuralgias due to exposure to cold, in hysteric neuralgias, and in post-pleuritic intercostal neuralgia.

Much profit may be obtained from thermocauterization in *myelitis* running a sluggish course; in the stage of decline in acute myelitis, when the phenomena of irritation of the acute stage show a tendency to disappear, and systematically in chronic forms of myelitis.

Cauterizations are also employed in *pulmonary congestion.* In hypostatic lung congestion and in the lung consolidations common in prolonged influenza they are capable of yielding great service by reason of their reflex vasomotor effect.

Most writers also recommend them in the following two conditions:

1. In the perituberculous congestions, without fever and relatively evanescent, which appear in the tissues surrounding an old tuberculous lesion.

2. In the perituberculous congestions met with in many actual consumptives in whom fever is absent.

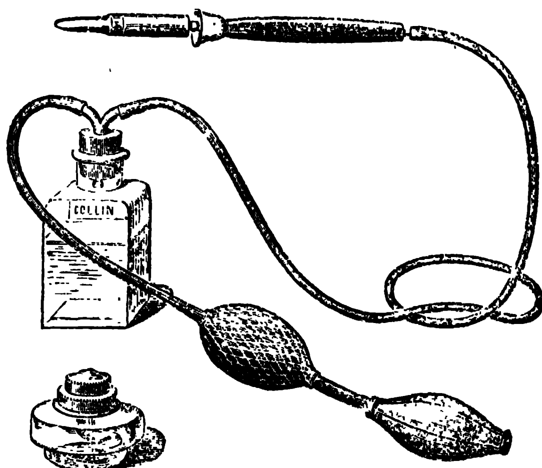


Fig. 117.—The Paquelin thermocautery.

Lastly, the procedure is an excellent adjunct to the treatment by diet, cholagogues and alkalies in *congestion of the liver,* of whatever cause, and in the stage of decline in *pleuritis.*

The contraindications to thermocauterization are: *Fever,* particularly in consumptives, and *degenerated heart,* particularly in arteriosclerotics.

Fig. 118.—Platinum galvanocautery loops.

Apparatus.—There are two forms of apparatus—the galvanocautery and the thermocautery.

The **galvanocautery** consists essentially of a loop of platinum wire which is brought to a red heat at will by passing an electric current through it.

The platinum loop is of various forms according to the purpose intended. There are special forms for the larynx, pharynx and nasal cavities.

The cautery or galvanic loop is fixed to an insulating handle. The conducting wires enter at the posterior end of the handle, while the cautery loops are adapted at the anterior end. The handle bears an interrupter which breaks the current when the cautery is not in actual use. This arrangement presents the marked advantage of permitting the introduction of the instrument into a body cavity while still cold.

A strong current is required, as the cautery loops to be heated are rather massive. A platinum cautery consumes 15 to 20 ampères of current.

The current may be obtained either from battery cells, accumulators, or directly from the city lighting circuit under certain conditions.

To heat the galvanocautery, the cautery selected is adapted to the binding devices provided on the handle and the conducting wires, connected at their other ends with the battery, also fastened to the handle. Pressure on the button closes the circuit and the platinum blade is heated to a varying degree; cauterization of the tissues can be effected at this juncture. As soon as pressure on the button is released the current stops flowing.

When a continuous action of some duration is desired, the circuit is kept closed. If the cautery is at a white heat where only a cherry-red heat is desired, the current is regulated by means of a rheostat. When the treatment is finished, the conducting wires are disconnected and the platinum blade removed.

The **Paquelin thermocautery** is in current use. It is designed in accordance with the principle that platinum heated to a red heat will remain incandescent upon contact with a mixture of air and inflammable vapor.

It consists of a hollow blade of platinum fixed to a wooden handle; a receptacle for the fuel, and a rubber bulb system like that on spray apparatus. There are several kinds of platinum blades; some end in a more or less narrow point.

Preliminary Preparations.—The part to be cauterized should be carefully cleansed and wiped off so that no moisture remains.

The physician should also make sure that the apparatus selected is in proper working order.

Technic.—In executing local cauterizations the operator should be able to use his hands in a dexterous manner and should proceed with the measure briskly, with neither precipitation nor hesitation; each cauterization will thus be complete at the first attempt and the pain very slight. The cautery should be brought to a bright red

heat, with avoidance alike of a white heat and of a dark red, the former being too severe and the latter insufficiently hot.

In removing a small skin growth, such as a pedunculated papilloma, the operator's left hand lays hold of the tumor with tenaculum forceps while his right hand, holding the cautery, burns through the pedicle of the tumor. The final step consists in destroying the area of implantation of the tumor with the cautery.

In acne, carbuncle or phlegmonous conditions, the cautery is applied either to make an opening into the pus cavity or, after incision with a knife, to cauterize the entire deep surfaces of the lesion.

In using the thermocautery the platinum loop is first heated to redness by holding it a few moments in the upper part of the flame of an alcohol lamp; as soon as it is red, fumes of benzine are blown through and the instrument is ready for use.

The temperature reached by the platinum tip will depend on the amount of pressure applied to the rubber bulb. When the cauterization is finished, the cautery should, before it is allowed to cool, be heated to a bright red in order to burn away any carbonaceous particles that may have become deposited either within or outside of the platinum blade.

Untoward Results.—No untoward results will occur unless the apparatus is not working well; this should be seen to before it is used.

After-care.—The cauterized areas may be dusted with talcum powder.

When a small growth has been removed, a dry dressing should be applied.

In the case of a suppurative process or carbuncle, a wet dressing should be used.

VIII.—CRYOTHERAPY.

By A. Lutier, M.D.

Cryotherapy consists of treatment with a pencil of carbon dioxide snow. It has been applied with good results in the treatment of certain skin diseases.

INDICATIONS.—In *lupus erythematosus*, cryotherapy gives excellent results.

Certain *small basal-cell epitheliomas of the face, nevi,* and *port-wine marks,* or *vascular nevi* heal well with complete absence of scarring.

Favorable results have been obtained in certain forms of *acne,* in some very painful forms of *corns* and *calluses,* and in *warts.*

Keloids are modified in a very esthetic manner.

APPARATUS.—Carbon dioxide snow is produced by abruptly decompressing liquid carbon dioxide, available on the market enclosed in metal cylinders.

The Lortat-Jacob apparatus (Fig. 119), charged directly, has marked a great step forward in the therapeutic use of carbon dioxide snow. This cryocautery has the great advantage of being sterile, whereas a single pencil of carbon dioxide snow is not aseptic.

It consists of:

1. A central metallic tube, terminating in a point of copper; the end is provided with a thread upon which may be screwed a plug perforated in its center by a notched opening.
2. A sleeve of wire gauze, for releasing the pressure, having a diameter less by a few millimeters than the tube itself.

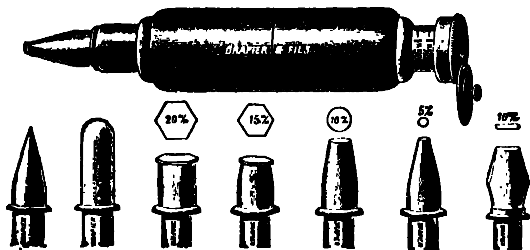


Fig. 119.

3. A spring spirally encircling the tube, to indicate the pressure applied (from 500 grams to 2 kilograms), as shown by a gauge at the upper part of the tube.
4. An insulating fiber cover, which is detachable.
5. A cylindroconic nozzle affording connection with the cylinder.

WORKING OF THE APPARATUS.—In charging the apparatus, the cryocautery is taken in the left hand by the middle of its protecting envelope, the upper opening is held against the nozzle, while with the right hand the screw of the carbon dioxide cylinder is opened. At this juncture a noisy jet indicates that the carbon dioxide is undergoing decompression in the apparatus; it is transformed into snow. The tube is known to be full when the particles of compact snow escape by overflow.

The cryocautery is now withdrawn from the ferrule and its interior is observed to be filled with a pencil of snow. About 3 cubic centimeters of acetone are next poured into the tube; a boiling sound is heard in the device, showing that the refrigerant mixture is ready.

The cautery must be of a shape suitable for the surface to be treated, and there is provided a whole set of cylinders ending in differently shaped points (flat, round, square, or pointed).

TECHNIC OF THE APPLICATION.—The surface to be treated is first cleansed with ether and alcohol. The point suitable for the particular case is selected. The cautery must be applied only when it is covered with frost.

The duration of the application varies greatly according to the lesions to be treated: In lupus, 10 to 20 seconds; in warts, 60 to 90 seconds. It is well to begin with applications of short duration and to increase the time according to the reactions. The pressure exerted varies according to the region operated. The upper portions of the nose, resting on a bony foundation, require less pressure than the cheeks.

Tissue compressed by the cryocautery becomes white, hard, and depressed. This aspect rapidly disappears and is replaced by that of an erythematous patch.

AFTER-CARE.—The application of carbon dioxide snow is a little painful; it is followed by intense congestion, which is rather distressing, and sometimes by edema (eyelids).

The patient should be warned not to expose himself too soon to the outer air, especially in winter, and to cover the parts treated with a thick paste.

Moist dressings should not be used. Blisters should be opened during the succeeding days with a sterile needle.

The small scab formed becomes detached at the end of about twelve days, and a new application of the cryocautery, if required, may be made at the expiration of two or three weeks.

II

THERMAL APPLICATIONS.

I.—HOT COMPRESSES. POULTICES.

Indications.—Hot compresses or poultices have very many indications: Placed over the trachea, they act extremely well in relieving attacks of *false croup;* over the chest, in *pulmonary* or *pleural affections,* they allay obstinate cough, reduce or eliminate dyspnea, and facilitate expectoration; applied over the abdomen or kidney region, they are very effective in cases of *hepatic, uterine* or *renal colic* and in *gastric* or *intestinal disorders.* They are used in *chronic inflammatory conditions* of the abdominopelvic organs (adnexitis, parametritis) to accelerate the absorption of exudates.

Hot Compresses.—In making hot compresses one may use either muslin, flannel or blankets rendered soft by use. The compresses are dipped in water as hot as possible, thoroughly wrung out, quickly untwisted, applied to the patient and covered with some impervious material. Care may be taken to tuck in the edges of the impervious material so that the latter will include all of the compress, and to cover it with some dry material which is a poor conductor of heat, such as flannel or wool, so that the compresses will retain their heat as long as possible. To be effective, the hot compresses should be renewed every 15 minutes. Two sets of compresses should be in use, each set being prepared before the preceding one is removed, so as not to have to uncover the patient twice and make him wait.

Hot compresses moistened with a decoction of camomile or poppy heads may be used. In preparing the poppy-head decoction, 100 grams (3 ounces) of thoroughly dry poppy heads are broken up, the seeds removed and the remaining fragments boiled for 15 minutes in 1½ liters (quarts) of water. The camomile decoction is prepared similarly by boiling camomile flowers for 10 or 15 minutes.

Poultices.—In preparing a flaxseed poultice, the flaxseed meal is moistened with water so as to make a clear mixture, without any flakes. This is then heated, with constant stirring, in order to keep the paste from sticking to the bottom of the pan. The stirring is discontinued when the mass has reached a suitable consistency.

The paste is then spread in its boiling condition over a piece of thin fabric, such as muslin gauze, twice as large as the size of the

intended poultice; the edges of the fabric are now folded about the poultice so as to enclose the paste completely in it and prevent its escape at any point. The side to be applied to the affected area is that along which the fabric is not folded in.

The poultice should be about 12 millimeters (½ inch) thick. Poultices that are too thick are heavy, while when too thin, their warmth is lost too rapidly; both of these extremes must be avoided.

The poultice thus prepared is rolled up in a piece of oiled silk to keep it from cooling and brought into the sickroom, when it is applied over the involved area. The oiled silk is intended to keep in the heat as long as possible; it should cover the poultice, but not pass between it and the skin.

A poultice should be as hot as the patient can stand without actual discomfort. It should always be prepared at as high a temperature as possible, as poultices cool quickly at best and exert their full effect only when very hot. When a poultice is intended to serve as a medium for some active drug, the latter is placed over the surface of the poultice before use.

Mustard Poultice.—In preparing a mustard poultice, a layer of mustard flour of varying thickness is dusted over the surface of an ordinary flaxseed poultice. Or, equal parts of mustard flour and flaxseed meal may be mixed together in preparing the poultice; in doing so, the mustard should be carefully moistened with a little water before the flaxseed meal is added.

Laudanum Poultice.—Thirty or forty drops of laudanum are placed on the side of the poultice which is to be brought in contact with the skin.

Starch Poultice.—Potato starch, 100 grams (3 ounces); water, 1 liter (quart). Moisten the starch with twice its weight of water and add to it gradually, while stirring, the remainder of the water, previously heated to boiling. Then boil for a few moments, meanwhile stirring the mass.

II.—ICE APPLICATIONS.

The therapeutic use of cold generally resolves itself into the application of the ice-bag or, less frequently, of a rubber tube through which very cold water is kept constantly flowing.

Indications.—The ice-bag or coil on the *head* is used in *acute meningitis, cerebral rheumatism* and *congestion of the brain.* Prolonged application of cold to the *back of the neck* produces sedation of the heart-action

and respiration through propagation of the effect to the cervical cord; it also acts as sedative on the genital reflexes.

The ice-bag over the *precordium* is used in *nervous tachycardia,* especially in the *tachycardia of exophthalmic goiter.* Such an ice application constitutes, indeed, a very powerful moderating action on the heart-muscle. It also produces a tonic effect on the heart; in addition, it has been observed that an ice-bag applied to the chest-wall will reduce the internal temperature. The precordial ice-bag is likewise much used in *typhoid fever,* especially when endocarditis or myocarditis seems to threaten. Applica-

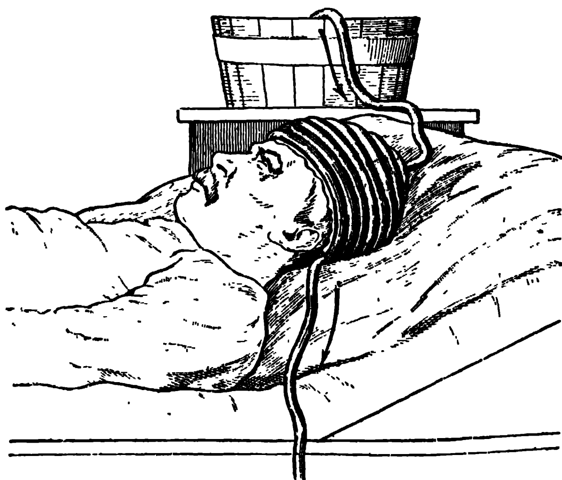


Fig. 120.—Rubber tube with cold water flowing through it, applied about the head.

tion of ice to the abdomen is a standard measure in the treatment of *acute peritonitis, appendicitis, adnexitis* and *perimetritis.*

Ice is also availed of for local application in *strangulated hernia, acute orchitis* and *some sprains.*

Preliminary Preparations.—Cold acting uninterruptedly on a given part of the body annuls the sensitiveness of the latter like an anesthetic and ultimately would even induce gangrene. Accordingly, ice should never be placed directly over the skin, but a piece of linen or flannel, folded in two, should always be interposed, in order to keep the skin from freezing and to absorb the moisture condensing on the surface of the ice-bag. This flannel should even be changed frequently so that it may be actually dry and do all that is expected of it.

Apparatus.—The ice-bag consists of a rubber bag with a screw cap. If the ice is to be broken up in the sick-room, unnecessary noise should be avoided; a very sharp-pointed instrument should be used for the purpose.

Technic.—Ice-bags should be only half filled, to avoid their being too heavy. Care should be taken to remove as much of the air from them as possible before screwing on the cap, so that they may lie flat when applied. In cases of extreme tympanites the discomfort experienced by the patient from the weight of the ice may be avoided at the start by suspending the ice-bag from a hoop. After a few hours, however, a relative insensibility of the abdominal wall will have resulted from the effects of the ice, which can then be applied directly. To prevent displacement of the ice-bag a loose bandage around the body is used.

The physician should not rest content with ordering ice applications over the abdomen, without bothering himself about how his instruction will be carried out. When the abdomen is not distended a single ice-bag is sufficient, provided it is a broad one and is laid flat over the surface; but since the abdomen is generally distended, the ice-bag may not stay in place, but will shift to the right or left, so that sometimes it is found on the bed by the patient's side. To keep it from falling off it may be fastened to the metallic hoop used to prop up the bed coverings. In this event, however, the ice-bag will often be in contact with the abdomen only over an insufficient area, and when the abdomen is palpated, it will be found that the skin has not been cooled in the least by the ice-bag, the latter having become warm and containing merely tepid water. That the ice should exert any useful effect under these circumstances would be unlikely. Hence, when the abdomen is distended with gas, do not be satisfied with a single ice-bag, but apply at least two, one over each iliac fossa; if two are insufficient on account of marked distention, apply a third one over the umbilical region, and if severe vomiting is present, even a fourth ice-bag may be placed over the epigastrium.

The duration of the ice application is as variable as that of the disease itself. As a rule, it is well to continue the ice for a while after termination of the acute manifestations, say, five, six, seven, up to ten days, or until the abdomen shall have regained its softness and lost its sensitiveness.

Renewal of the Ice.—Ice-bags require a considerable amount of attention; if they are not removed as soon as the contained ice has melted, the cessation of the cold application will result in a reaction and an effect opposite to that desired. Fresh ice should be introduced, therefore, as soon as that in the ice-bag has melted—generally every three

hours. The ice should be renewed during the night as well as in the daytime.

Each time the ice is renewed the abdominal wall should be inspected, and if a small grayish or purplish area is seen to appear, this is a sign that the cold applied has been too intense. Removal of the ice-bag is not thereby rendered necessary, but a thicker layer of flannel should be interposed beneath the ice-bag, and the point of contact of the ice-bag shifted to another place.

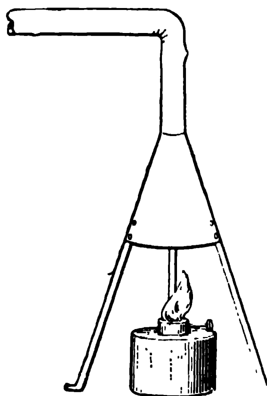


Fig. 121.—Air heating device: Lamp, funnel and pipe.

III.—HOT AIR.

Hot air is used in two different ways, according as the part to be treated is exposed to the heated air in a closed space (hot air bath) or to the action of a blast of heated air (hot air douche).

Indications.—Hot air yields excellent results in the relief of pain in *lumbago, joint inflammations, chronic rheumatism* and *sciatica;* of post-traumatic *stiffness of joints;* of *trophic disturbances, frostbite, gangrene, sluggish wounds* and *varicose ulcers,* and of effusions, *edema, hydrarthrosis of the knee* and *synovitis.*

Apparatus.—The armamentarium includes a considerable number of devices offered by manufacturers. Very convenient apparatus can, however, be constructed at home at little expense.

The hot air apparatus consists essentially of a box of well-seasoned wood. Circular openings are provided for the insertion of any portion of the body to be treated; in the case of the middle portion of a limb, a second opening is made on the opposite side of the box

through which the extremity of the limb may protrude. Broad rings of wood, padded with non-inflammable felt, are fastened in these openings, so that the limb can rest comfortably in them during treatment. At the margin of each of these rings is provided a felt cuff, to be fastened around the limb. The inlet opening for the heated air is bored in one of the other sides of the box; within it is inserted the metallic pipe from the heating device. The air goes out again through one or two openings through the upper surface of the box; the sectional area of these openings should be about half that of the inlet opening. Through the roof of the box is also another small opening just large enough to admit a thermometer graduated up to 200° C.

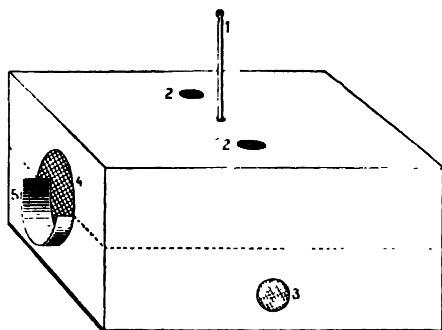


Fig. 122.—Hot air apparatus.

1. Thermometer. 2. Two holes for the outgo of air. 3. Opening into which is fitted the pipe from the heating device. 4. Opening for the insertion of the patient's extremity. 5. Semicircular support for the limb.

Within the box there is provided, a short distance from the inlet pipe, a small board serving as a screen, to keep the hot air from streaming too directly onto the part under treatment. A cushion covered with non-inflammable material is also placed inside the box; it is intended to support the patient's hand or heel, which might otherwise be burned through direct contact with the wood of the box.

The size of the box varies according to the member to be treated. A box for the knee may be, *e.g.*, 50 centimeters (20 inches) long, 37 centimeters (15 inches) broad, and 40 centimeters (16 inches) high (Durey). The source of heat is an ordinary alcohol lamp or a gas burner. Over the source of heat is placed an inverted sheet-iron funnel connected above with a sharply bent air pipe, the horizontal limb of which fits into the side opening in the box. A metallic disk

in the funnel obviates the risk of passage of the flame into the box, which might be caused by a draught of air.

Preliminary Preparations.—The patient should be placed in a comfortable position, sitting or lying down; the treatment takes considerable time, and an uncomfortable position would become intolerable. The member to be treated is placed *unclothed* in the hot air box: If clothing or a dressing were around it they would become soaked with perspiration, of which they would prevent rapid evaporation; the application of dry hot air would thus be turned into a warm moist application. In the case of the foot, however, one finds it necessary to cover the toes with a little hood of wool impregnated with silicate in order to prevent too distressing a sensation of heat by reason of the greater sensitiveness of these parts and their situation in the upper air layers in the box, which are the hottest.

Technic.—A box of appropriate shape for the region to be treated should be obtained. Treatment of too large a portion of a limb at one time should be avoided; the smaller the part in which the venous hyperemia is produced, the more readily the desired result is obtained.

The forms of apparatus for the foot are provided with a small felt-covered stool which is placed on the bottom of the box and on which the heel is to rest. The toes are then covered with the little felt hood supplied with the apparatus—unless gangrene exists, in which case the toes are left uncovered.

The apparatus for the hand is provided with a felt-covered handle which is fastened by two cords to hooks on the under surface of the top of the box; the hand is supported by this handle and the forearm rests on the edge of the box, which is broadened at this point for the purpose.

The apparatus for the entire leg includes the same devices for the heel and toes as that for the foot.

In the apparatuses for the knee and the elbow, the limb is introduced in the box so that the joint lies in the middle of the latter, the foot or hand projecting out of the box.

The boxes are provided within with a protecting screen fastened in place by hooks; this screen, which is placed in front of the inlet opening, prevents the entering hot air from striking the limb directly.

The boxes for the knee, elbow, hand and leg are provided with two openings through which the pipe from the source of heat can be inserted at will on the right or left; before introducing the limb into the box, care is taken to place the protecting screen in front of the opening to which the hot air pipe is fitted and to close the opening

on the opposite side of the box with the metallic obturator provided for the purpose.

The limb should be free in the box and should come in contact neither with the sides of the box nor with the thermometer.

The preparation of the patient is completed by carefully calking the openings by means of pieces of woolen material passed about the leg or arm over a layer of non-inflammable woolen fabric.



Fig. 123.—Hot air treatment of the arm.

The thermometer is inserted through the hole down to about 38 or 40° C.

The lamp is then lit and placed below the funnel.

The maximum heat should be reached only gradually. The intensity of heat is regulated by reducing or increasing the flame, by lowering or raising the lamp or, if required, by removing it from under the funnel. About five minutes should be consumed in reaching 70° C. Becoming accustomed to the heat, the patient can bear 100, 110 or 115° C. without distress. At 50° the limb is already slightly moist, as a rule; about 70° it perspires copiously.

The degree of heat to be attained varies according to the disease and the patient. At the first sitting, a temperature exceeding 80°

should be avoided. One should beware of certain patients who insist on exceeding the temperature prescribed or on continuing the sitting too long; burns might be observed in such cases.

The treatment should occupy about 45 minutes, not exceeding one hour, should be repeated daily, and should be given preferably before meals.

When the maximum degree of heat desired has been reached (115° not being exceeded, as a rule), this temperature is carefully maintained. At the end of the sitting the temperature should be allowed

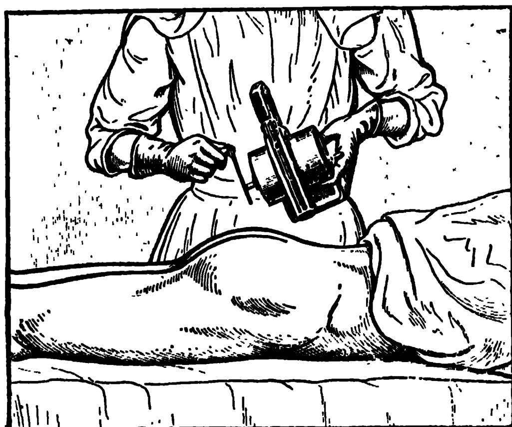


Fig. 124.—The hot air douche.

to descend gradually. The box should be opened only after the temperature within it has gotten down below 39° C.

Local application of hot air causes a slight rise in the body temperature, a rise in the pulse rate and breathing rate, and even, in some instances, headache and a feeling of lassitude and depression. If these fatigue sensations are pronounced or the patient complains of sleeping poorly, the treatments should be shortened or suspended.

In general, in the treatment of rheumatic conditions the hot air applications are made at a temperature of 115° for thirty minutes; for trophic disturbances, ulcers, gangrene or edema the treatments are of one hour's duration at 80°.

The Hot Air Douche.—The hot air douche is administered with one of the many instruments for the purpose on the market, consisting essentially of a device yielding a stream of air, with the hand or electricity supplying the motive force, and a heating device involving

the use of alcohol, gas or electric resistance. In applying such a hot air douche the thermometer cannot be relied on for guidance, and the sensations of the patient should be taken as the guide.

The stream of air applied should always be very hot—from 120 to 150° C. There would be no object in beginning with lower temperatures; the maximal temperature should be reached at once. The stream of hót air should be moved about just as the gardener would be constantly moving the spray from his watering-can, at a moderate rate, without ever stopping at a single point. The orifice of the apparatus should be at a distance of about 10 centimeters (4 inches) from the skin.

Each treatment should continue at least ten minutes; generally it will be advisable to have it kept up for twenty to thirty minutes.

III

SUBCUTANEOUS PROCEDURES.

I.—THE SETON.

A seton is an artificial channel through superficial tissue kept open by means of a strip of fabric passed through two openings made in the skin. A localized suppurative process is thus obtained.

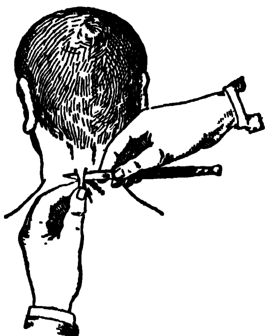


Fig. 125.—The point of the knife is passed completely through a fold of skin.



Fig. 126.—In the second step in the institution of a seton, a wick of fabric is passed under the skin and emerges through the two openings in the latter.

The seton may be applied in any part of the body, but the commonest site for it is the back of the neck. In establishing the seton a longitudinal fold of the skin is lifted up and pierced with a knife. After this incision has been made a pointed instrument with a wick of fabric affixed is pushed through the opening along the knife and the wick allowed to remain *in situ*.

II.—THE FIXATION ABSCESS.

The fixation abscess is now generally preferred to the seton.

Indications.—Recommended as having given good results in infections in general, and notably in puerperal sepsis, pneumonia, etc., the fixation abscess, sponsored mainly by Fochier, of Lyons, has been of

much service in the treatment of influenza and is one of the best measures as yet known for combatting lethargic encephalitis.

As the pus in the fixation abscess should be sterile, it is important that the induction of the abscess and its evacuation should be carried out with careful aseptic precautions. Failing this, complications may be observed which will keep up the inflammation induced for a long period and cause extensive separation of the tissue layers.

Technic.—An ordinary 1-c.c. hypodermic syringe is carefully sterilized and filled with oil of turpentine. The fresh oil is less offensive but somewhat less active than old oil.

The site of injection having been cleansed, the turpentine is injected in the cellular tissue, either on the outer aspect of the thigh, the side of the body, the deltoid region, the lumbar region, the outer aspect of the leg, etc. Generally the outer aspect of the thigh is selected on account of the ease of manipulation it affords.

After-effects.—Pain at the point of injection begins after a few hours and soon becomes severe. Frequently it becomes necessary to allay the pain with large wet dressings. Later, considerable swelling appears, together with red patches which might be taken to suggest a beginning diffuse suppuration. By the second or third day the inflammatory phenomena become localized, fluctuation appears, and the pain tends to subside.

When the abscess has formed it is opened and dressed. The incision is generally carried out about the fifth or sixth day. It can be made sooner than this if the abscess is deemed to have produced its effect and the disease to have been checked.

Absence of a reaction following the injection of turpentine is an unfavorable prognostic sign. When the procedure fails, the production of a second, and even of a third, abscess is warranted. The same course may be followed where the first abscess appears to have given only an insufficient result.

The institution of fixation abscesses is not an entirely innocuous procedure. Some disastrous results have been recorded (Nigay).

III.—LOCAL TREATMENT OF EDEMA.

CUTANEOUS DRAINAGE.

Drainage of the skin has for its purpose to provide a direct outlet for non-inflammatory edematous fluid infiltrating the subcutaneous cellular layers.

Indications and Contraindications.—This procedure is indicated whenever, in chronic disorders (edema of cardiac or renal origin, or due to hepatic cirrhosis or neoplasms), the peripheral edema increases in spite of the customary treatment—salt-free diet, tonic and diuretic medication, and gentle, progressive massage.

It is absolutely contraindicated when the skin is the seat of infection.

Apparatus.—This varies according to the procedure employed. The physician may choose between:

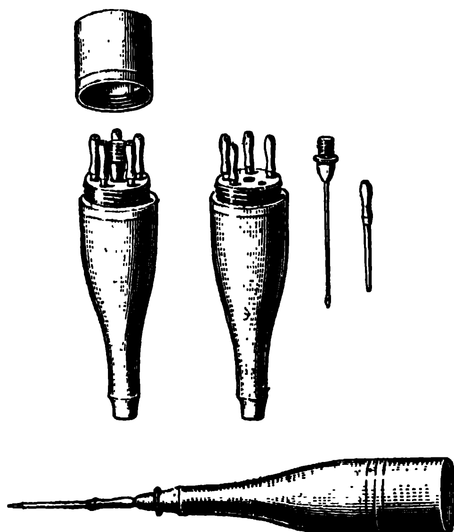


Fig. 127.—Southey's tubes.

1. Cutaneous drainage by means of trocars.
2. Small stab incisions.
3. Scarification of the skin.
4. Deep incisions of the skin.

The first of these procedures requires the use of Southey's capillary trocars ("Southey's tubes") or of Curschmann's lancet-trocar.

There should also be available:

Four rubber tubes with an inner diameter of 3 millimeters (1/8 inch) and 120 centimeters (4 feet) long.

Alcohol or ether.

Tincture of iodine.

Two graduated jars each with a capacity of 2 or 3 liters.

Sterile compresses.

A large supply of absorbent cotton.

Sterilized gauze strips 5 or 6 meters (16 to 19 feet) long.

Safety pins.

The other three procedures require a lancet or needle and a scalpel.

Preliminary Preparations.—The utmost aseptic precautions should be taken. The patient's skin should be washed with soap and carefully rinsed, shaved if need be, then disinfected with alcohol or ether. The instruments, cannulas or drainage tubes should be sterilized by boiling or otherwise.

The bed should be protected with oilcloth covered, in turn, with a sheet folded several times.

The physician should proceed to make his hands surgically clean.

Technic.—In establishing the drainage one should select the dependent portions of the body, avoiding surfaces in which the skin is too tense, imparting the impression of a hard, lardaceous edema to the palpating hand. The areas of election are: The sides of the abdomen, the outer aspects of the thigh and leg, the instep, and the surfaces posterior to the malleoli.

Drainage with Trocars.—*First Step.*—The area selected is disinfected with iodine.

Second Step.—The trocar is introduced somewhat obliquely into the tissues, and the needle within it withdrawn while the cannula is held in place with the left hand. A few drops of clear serum will at once appear. If blood should appear instead, the cannula should be withdrawn and reinserted elsewhere.

Third Step.—A rubber tube is fitted onto the trocar.

Fourth Step.—The trocar and its rubber tube are fixed in position. Two turns of gauze bandage are applied on either side of the cannula and drawn moderately tight. Safety pins are passed through the bandages above and below the cannula and the latter fastened to them with threads. Another safety-pin is inserted at the edge of the bed and the rubber tube fastened to it with a thread.

Drainage through Small Stab Incisions.—A pointed lancet, needle or scalpel is plunged perpendicularly into the tissues and withdrawn without enlarging the wound. No drainage tube is inserted, but the limb merely covered with a thick layer of cotton.

Scarification of the Skin.—The patient is seated, with his feet in a tub. Four or eight short incisions are made in the skin of the calf down to the fascia. The exuded fluid passes into an absorbent dressing. Several liters of serous fluid may be discharged in one day.

Extensive Skin Incisions.—This operation is carried out with a scalpel. It yields such a copious outflow of serous fluid that it is hard to collect the latter in absorbent dressings. The healing of such wounds, made in skin which is distended and poorly nourished, is slow.

Untoward Results.—Constitutional disturbances, including delirium and syncope, may follow unduly copious exudations of fluid (cases in which 27 liters of fluid were lost in eighteen hours through nine tubes have been reported). The number of tubes should be limited to four or six, so as to obtain at most 2 to 4 liters of fluid in twenty-four hours.

Hemorrhage is not a serious complication. The cannula concerned should be taken out and a compression dressing applied.

Oozing sometimes continues after removal of the cannula. An occlusive dressing with collodion should then be applied; if this proves insufficient, an aseptic compression dressing should be applied.

The complication most to be feared and most serious is infection (lymphangitis, erysipelas), which is to be apprehended especially in cases of edema of renal origin, where the tubes are to be changed every twelve hours.

The points of drainage should be carefully watched and treated with the most scrupulous asepsis.

After-care.—The outflow from the tubes should be kept under observation. If they are not showing a proper output (about 1 liter a day) they should be examined for obstructing material. If such material is present, they should be opened up by cleansing or aspiration; if not, they should be reinserted in a new place.

The tube should be changed every twelve to twenty-four hours, according to the tolerance of the patient's skin.

If an absorbent dressing is being used, it should be renewed according to the fluid taken up.

Absolute cleanliness of the limbs under treatment should be maintained and the dressings should be aseptic.

The patient should be kept under watch and suitable measures applied in the event of faintness.

If the flow of fluid stops, petrolatum should be applied over an extensive area of the skin.

IV

SUBCUTANEOUS AND INTRAMUSCULAR INJECTIONS.

I.—SUBCUTANEOUS AND INTRAMUSCULAR INJECTIONS.

Such injections are the procedures of choice in the administration of very many drugs, insuring their rapid and certain absorption, affording accuracy of dosage, and avoiding disturbance of the gastric functions. They are a necessity in the giving of certain remedies, such as the therapeutic serums and the mercurial salts.

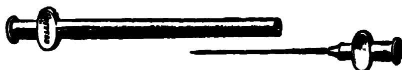


Fig. 128.—New style of needle. A species of metal plate at the proximal end of the needle permits of holding and handling it more easily.

Instruments.—The best syringe is one composed wholly of glass, with a glass plunger.

The needle may be of steel, or better, of nickel or iridioplatinum so that it may be heated in a flame without injury and without risk of fracture during an injection.

Asepsis of syringes and needles is readily obtained; boiling in plain water is sufficient.

The solution to be injected is drawn up into the syringe from a small receptacle, sterilized by boiling, in which the required amount of solution has been poured. Fluid from a bottle should not be drawn up with a needle that has not been disinfected after already having been used in an injection. If an ampule is being used, its contents is drawn up directly from it into the syringe.

The syringe having been filled, any air-bubbles it may contain are driven out by placing it vertically, with the plunger below, and pushing the latter up a little until the air-bubbles have been forced out.

Technic of Subcutaneous Injections.—The *sites of election* for such injections are those where vessels and nerves are few and cellular

tissue abundant. For simple subcutaneous injections the outer aspect of the forearm or thigh is generally chosen. Tincture of iodine is applied at the point selected. In making the injection, a large fold of skin is lifted up with the thumb and forefinger of the left hand and the needle inserted quickly at the base of the fold. As soon as the dermis has been completely pierced (as shown by a sensation as of resistance overcome), the plunger is pushed home gently so as to drive the fluid slowly into the subcutaneous cellular tissue.

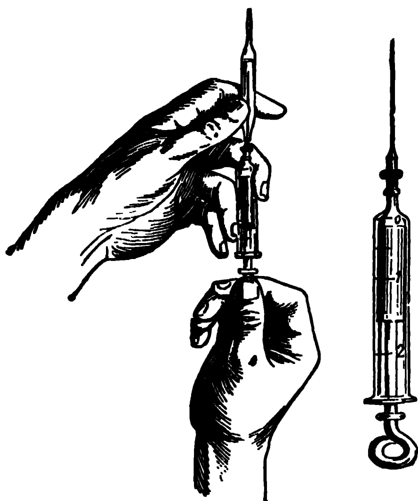


Fig. 129.—Procedure in drawing fluid from an ampule. One hand holds the ampule and the syringe, while the other hand draws out the plunger.

When the syringe has been emptied, the needle is withdrawn somewhat obliquely and by a single quick motion. The fluid injected produces beneath the skin a small elevation, which soon disappears.

Technic of Intramuscular Injections.—Selection of the Site.—In the case of oily or irritating fluids, the needle should be inserted deeply, passing through the adipose layer and penetrating into the muscles. For this purpose it is well to provide one's self with a needle longer than the ordinary needles (4 to 5 centimeters—1½ to 2 inches), so that the fluid may be injected quite deeply, in the thickness of the muscular tissue. Intramuscular injections are well borne only in regions where there are thick masses of muscle tissue and which are not crossed by large vessels or nerve-trunks. The upper

gluteal region is the most favorable and frequently availed of site for intramuscular injections.

According to P. Ravaut, the best plan is to map out an area in which any point would be suitable for injection provided the most fleshy place were selected. This area varies according to the musculature of the in-

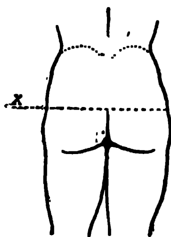


Fig. 130.

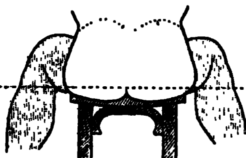


Fig. 131.

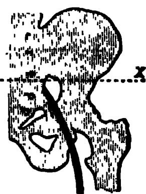


Fig. 132.

dividual and according to the sex. The proper zones may be located as follows:

(*a*) If the patient is standing, the injection should always be made above a horizontal line passing through the upper extremity of the intergluteal fold (Fig. 130).

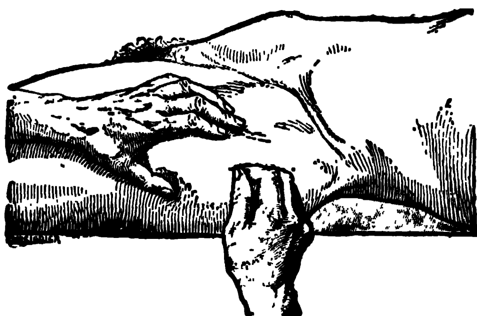


Fig. 133.—Deep injections. The detached needle is introduced in a direction perpendicular to the skin surface. This is the best procedure for subcutaneous injections.

(*b*) If the patient is sitting on a chair with his legs apart, the injection may be made in any portion of the buttocks that remains exposed (Fig. 131).

In injecting in the portions of the gluteal muscles situated in these zones one is certain never to encounter the sciatic nerve (Fig. 132). The point where the muscles are most prominent and thickest should

be selected. During a protracted course of treatment, it will always be easy to find new points for injection in the broad zones thus marked out.

Technic.—The area having been asepticized with tincture of iodine, the unattached needle is introduced in a direction perpendicular to the skin surface to a depth of 4 to 5 centimeters (1$\frac{3}{5}$ to 2 inches). If no blood flows from the needle, the syringe is then adapted to it and the injection gently made.

Untoward Results in Subcutaneous and Intramuscular Injections.—Untoward results are exceptional after subcutaneous injections; somewhat less rare after intramuscular injections.

Abscess Formation.—This is due to faulty asepsis. The clinical evidences are pain, an area of induration and lymphangitis around the puncture, followed by local pus formation. The abscess having been evacuated spontaneously or surgically, recovery occurs in a few days. Occasionally, however, severe phlegmonous processes have been observed after deep injection of irritant salts.

Superficial Necrosis.—When ether or an irritating solution is injected too superficially, a black patch of necrosis may develop. Healing of such an area is very slow.

Pain.—As a rule, no pain or but slight pain follows a subcutaneous injection; no attention need be paid to it. Following the injection of more or less irritating substances, however, such as ether or soluble salts of mercury, pain is seldom absent; it may be very pronounced, and the patients should be warned of this possibility.

Fracture of the Needle.—Breaking of the needle in the skin is an accident that may occur during subcutaneous injections; there is no great element of risk in it. Whenever operation is possible and easy, especially if the X-ray is available, extraction of the piece of needle should be carried out; in the opposite event, there is no great disadvantage in leaving it under the skin.

II.—SUBCUTANEOUS INJECTIONS OF SALINE SOLUTION.

This refers to the administration beneath the skin of considerable quantities (100 to 1000 c.c.—3 to 32 fluidounces) of saline solution.

Apparatus Required.—A large syringe may be used for the purpose, but the best procedure consists in the use of a fountain syringe or funnel connected with the needle by rubber tubing. With such a

device, the injection is carried out without any pressure other than that resulting from the difference of elevation between the receptacle —placed 1 to 1½ meters (3 to 4½ feet) above the bed—and the patient. The weight of the column of water is sufficient alone to force the fluid into the subcutaneous cellular tissue.

It is well to close the upper aperture of the receptacle with a pledget of cotton in order to filter the air entering into contact with the fluid to be injected.

Solutions.—A commonly used salt solution is that made by dissolving 7½ grams of sodium chloride in 1000 c.c. of distilled water. [*Liquor sodii chloridi physiologicus*, U. S. P., is of 0.85 per cent. strength.] Just

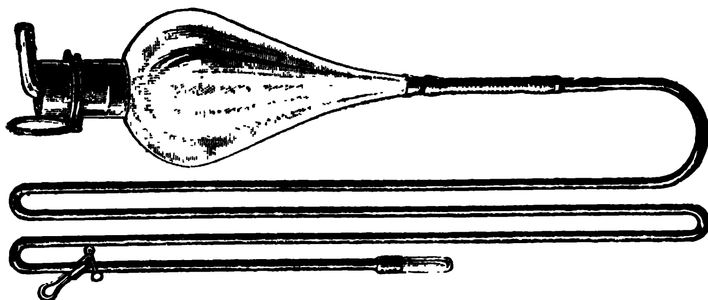


Fig. 134.—Hallion and Carrion device. This apparatus may be used for the intravenous injection of saline solution; the needle alone is changed for the purpose.

before use the solution should be warmed to a temperature of 30 to 38° C. (86 to 100.4° F.).

Sea water filtered through porcelain has also been used.

Sites of Injection.—The requirements for a proper site of injection are: Abundance of subcutaneous cellular tissue and convenient access for the operator.

Areas frequently selected include the trochanteric region or antero-external aspect of the thigh; the abdominal wall and lateral aspect of the trunk; the inner surface of the axilla, and the inframammary region; cellular tissue is particularly abundant in all these regions.

Necessary Precautions.—The patient should be recumbent. The site selected for the injection is painted with tincture of iodine. The sterilized saline solution is in the sterilized receptacle. The fluid is allowed to flow through the needle so as to drive out the air. The

rubber tube is closed between the fingers or by a metallic device for the purpose. The receptacle is raised to the desired elevation.

Technic.—The operator, holding up a fold of skin between the thumb and forefinger of the left hand, introduces the needle, already connected with the rubber tube, deeply beneath the skin and then lets the fold of skin go. The fluid passes into the cellular tissue and soon forms a distinct swelling. The apparatus is left undisturbed while the fluid is slowly passing out of it; warm compresses may be placed over the area of injection during this time.

When the intended amount of fluid has entered the cellular tissue, the flow is stopped by pinching the rubber tube and the needle withdrawn obliquely. The puncture made by the needle closes spontaneously.

Untoward Results.—This procedure, which is relatively simple, is never accompanied by untoward results when carried out with a sufficiently careful technic. Any infection that might occur would be due to overlooking of the aseptic precautions.

III.—SUBCUTANEOUS INJECTIONS OF OXYGEN.*

The **subcutaneous route** is now considered by many the route of choice when a definite amount of oxygen is to be supplied to the system promptly and completely. The action of subcutaneous injection is as pronounced and clear-cut as the absorption of oxygen through the respiratory tract is poor and relatively ineffective. The favorable effects of the introduction of oxygen into the system are the result of an oxidizing action on the tissues, a reflex stimulation of the nerve-centers and an analgesic and sedative action.

Applied in dyspneic cases, the measure brings about an almost immediate reduction of the rate of breathing, with respiratory movements of good amplitude.

It also leads to more forcible heart-action; it causes disappearance of cyanosis, while the patient experiences a sensation of soothing and of well-being.

Indications.—The hypodermic use of oxygen is indicated:

1. In all cases of acute asphyxia due to harmful gases or of slow asphyxia due to bronchial disease.

2. In cases of toxic impairment of the blood.

*[See also Part I: *Oxygen.*]

3. In cases of burns or of partial destruction of the bronchial mucous membrane.

4. In pulmonary tuberculosis.

5. In some surgical infections with anaërobic germs.

6. After hemorrhage. (Cell-counts have shown that oxygen administered hypodermically leads in a few hours to an increase in the number of red and white blood cells.)

Apparatus.—In emergencies, the procedure may consist simply in connecting the outlet tube of an oxygen tank with a hypodermic needle

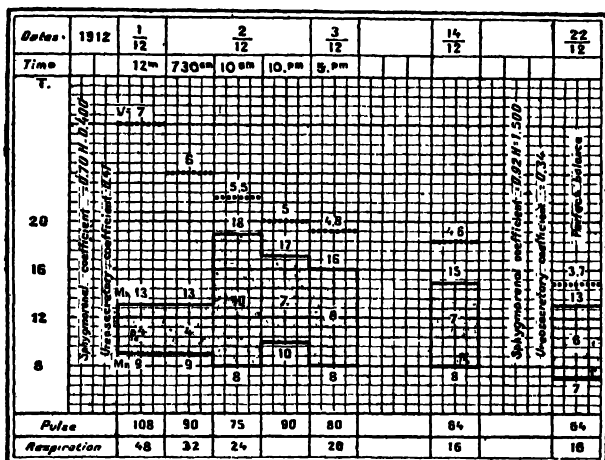


Fig. 135.—Acute hyposphyxia in an azotemic patient treated by hypodermic injections of oxygen.

V = blood viscosity. Mx = systolic blood-pressure in centimeters of mercury. Mn = diastolic pressure. P = pulse pressure. (Treatment: Venesection, hypodermic injections of oxygen, camphor in oil.)

and introducing oxygen into the tissues by making pressure on the rubber bag; this method is slow, however, and the outflow of oxygen uneven and its amount uncertain.

The best and most accurate, though costly, apparatus is the Bayeux oxygenator (Fig. 136).

Preliminary Preparations.—Local aseptic precautions should be taken as in an ordinary hypodermic injection.

Technic.—*Site of Injection.*—The outer aspect of the thigh and the abdomen are the best regions to inject.

The needle is inserted through the skin as for any other subcutaneous injection, the attempt being made, however, to reach the

tissue plane between the fascia and the lower surface of the dermis and adipose layer. Injection of oxygen into the subcutaneous fat should be avoided as much as possible. The formation of an even swelling of tissue or of small bubbles appearing beneath the epidermis indicates that the injection is taking place satisfactorily. There remains but to make pressure on the rubber bag until the amount to be introduced has passed in; or to wait until the oxygen receptacle has emptied itself if the Heckel apparatus is being used (seven to ten minutes), or until the desired amount has been introduced, with the Bayeux apparatus.

Amount to be Injected.—Oxygen is not toxic in any quantity; hence

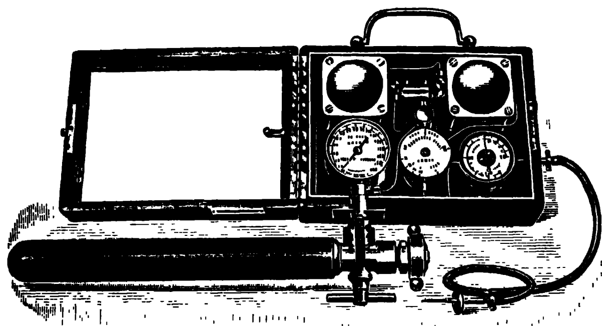


Fig. 136.—Bayeux's oxygenator.

in cases of illuminating gas poisoning, 5 or 6 liters of oxygen may be administered without difficulty.

A dose of 500 c.c., repeated if necessary, is suitable in major asphyxial states.

In conditions of anemia, tuberculosis, neurosis or malaria, three injections a week, each of 75 c.c., given in series of twenty injections, are generally sufficient.

Untoward Results.—No gas embolism nor any other sort of accident need be feared.

The only drawback is a feeling of pricking or tingling which the patient may experience during the injection. The more slowly the injection is given and the lower the pressure used, the less these sensations will be felt. A subcutaneous emphysema of varying extent and duration is always seen after the injection. It is of no consequence.

After-care.—A little tincture of iodine should be applied at the point of injection.

After the injection there may be heavy, crampy feelings in the limb. These are allayed by light massage, which also assists in the diffusion of the gas.

V

PROCEDURES RELATING TO THE CIRCULATION.

I.—LEECHING.

The application of leeches has for its purpose to remove a varying quantity of blood.

Indications and Contraindications.—Leeches may be used for purposes either of general blood-letting or of local blood-letting.

Leeches are credited with the capacity to withdraw about 15 c.c. (½ ounce) of blood each. This is about what would be collected by wet cupping; but as soon as the cup is removed the flow of blood stops, whereas in the case of the leech the blood continues to well from the wound for a period ranging from several hours to over a day, so that the amount of blood lost is usually from 100 to 200 c.c. (3½ to 7 ounces). This is due to the fact that leeching induces a temporary acute local hemophilia, the blood being rendered incoagulable at that point by the injection of a special substance present in the heads of the leeches and secreted by small glands located in the walls of the esophagus. Leeches present several advantages over wet cupping:

1. They are readily applied in any portion of the body. Leeches will take hold even in the most inaccessible areas; cupping is not applicable at certain points.
2. They are easily applied to inflamed or painful areas, where cups could not be applied.
3. A greater amount of blood is withdrawn in a given restricted area.

Leeching may be availed of in pericarditis, nephritis, lumbar neuralgia, some affections of the eye and ear, and congestion of the liver, lung or brain.

Leeches should not be applied in regions of the body where the skin is very thin or the cellular tissue is loose (eyelids, scrotum), otherwise extensive ecchymotic infiltrations might result; regions where there are large superficial vessels (jugular vein, temporal artery) should be avoided, as the leeches might open these vessels;

in women, surfaces exposed to view should be avoided, as the scars resulting from leech bites may sometimes be readily visible.

The Leech.—The medicinal leech (*Hirudo medicinalis*) is an annelid of the order Hirudineæ.

1. The body of the green leech has six reddish longitudinal stripes, and is greenish, with the ventral surface free of spots.

2. The gray leech likewise has the six reddish stripes; its body is of an olive color and the ventral surface exhibits black spots.

One should be able to distinguish the head end from the tail of



Fig. 137.—Application of leeches over the mastoid region.

the leech, in order to apply its active portion, *viz.*, the mouth, to the skin of the patient. The tail is the larger end and bears a large sucker which serves in the progression or attachment of the animal; the head end is the thinner extremity.

A serviceable leech weighs about 2 grams (30 grains). It should not have ingested any blood recently; no blood should issue from it when pressure is made on it from the anal extremity toward the mouth.

Leeches should be kept in a large (7 or 8 liter) jar, with sand at the bottom and two-thirds filled with water. A small stream of fresh water should be kept flowing constantly through the jar. Wire gauze should be fastened at the top to prevent escape of the leeches.

Accessory materials required in leeching comprise: Hot water, a playing card, a glass or a test-tube, tincture of iodine, compresses of cotton, a bandage, and some milk or sweetened water.

Preliminary Preparations.—The area selected should be cleansed with soap and tepid water, shaven if need be, then dried by rubbing the skin briskly. No soap should remain; otherwise the leeches would not take hold. The rubbing of the skin distends the smaller vessels, stimulating the leech to bite. If necessary the surface may be moistened with milk or sweetened water.

Technic.—When several leeches are to be applied at once, they may be placed in a cupping glass and the latter then turned over quickly onto the selected area; with this procedure, however, most of the leeches may take hold close together and near the edge, so that a circle of bites results. It is better, therefore, to place them in a compress with a central depression in the palm of the hand and turn the compress over against the skin.

To apply a single leech, it is taken between the thumb and forefinger, covered with a piece of fabric if desired, and applied by the oral end to the patient's skin; or, the leech may be placed in a glass tube, test-tube, or a rolled-up card, which is then applied to the part.

In applying a leech in the vicinity of a natural orifice, such as the anus, the leech should always be watched, lest it insinuate itself through the orifice into the rectum. The anus may be plugged, if necessary, with a tampon of cotton soaked in oil.

A leech applied to the skin, after moving about for a few moments, takes hold and remains motionless for a half, three-quarters or one hour, swelling visibly from the blood with which it is gorging itself. If it seems disinclined to let go, or when the amount of blood withdrawn is deemed sufficient, the leech should never be pulled off by main force, as this would rupture the animal's jaws, which would remain in the skin; some salt or ashes should be placed on it, or its tail cut off with scissors.

Untoward Results.—If the leech fails to take hold and lets go after a short time, it should be replaced by another, more active one.

The many instances of untoward results, such as erysipelas, lymphangitis or suppuration, formerly met with, were attributable to the manner of dressing the wounds rather than to the leeches themselves.

Occasionally it may be difficult to stop the bleeding. It is well not to let it continue too long in young patients. One of the many hemostatic agencies now available should be employed; the simplest is pressure; one may likewise resort to the application of a compress

wet with a 10 per cent. antipyrin solution, or to the application of horse serum or diphtheria antitoxin.

If, perchance, a large vessel, superficial vein or even a small artery should be opened by a leech, a suture could be passed through the skin to close the wound, or, more simply, a Michel's clamp could be applied. If a leech should enter one of the body orifices, an injection or enema of salt water would be indicated.

After-care.—The dressing is very simple, tincture of iodine merely being applied to the small wound and a gauze or cotton pad put on and held with a bandage. Frequently a considerable thickness of cotton is required to absorb the exuding blood.

Healing is complete in four or five days; there remain small, white stellate scars with three limbs, which are very characteristic.

II.—VEIN PUNCTURE.

Vein puncture is a procedure which consists in the introduction of a hypodermic needle into a vein either to collect blood or to inject a solution of some drug into the vessel. In the second instance, it constitutes the first step of an intravenous injection.

Indications.—Vein puncture may be carried out for diagnostic purposes, *e.g.*, for urea determination, blood culture, inoscopy or the Wassermann reaction, or for therapeutic purposes.

From the therapeutic standpoint it may be done:

1. As a form of blood-letting. It is particularly to be recommended in the repeated withdrawal of small amounts of blood (*e.g.*, once or twice monthly)—a valuable measure in uremic and cardiac cases. The amount to be thus withdrawn is from 100 to 250 c.c. (3 to 8 ounces); a needle of rather large caliber should be used.

2. As the initial step in intravenous injection—a procedure now increasingly used (see below).

3. As the initial step in blood transfusion (see below).

Instruments.—*The Needle.*—A needle of gold or platinum should be used in preference to a steel needle. To be certain of a successful vein puncture, the greatest attention should be paid to the bevel of the needle. The bevel of a freshly purchased needle is generally too long; after being sharpened a few times it becomes too short. A needle with an unduly long bevel may, as soon as it has penetrated the skin, pass through both walls of the vein at once, or, if it has passed through only one wall, blood may issue from the needle before the bevel has entirely passed into the vessel, whence the formation

of a hematoma and, during the injection, penetration of the fluid into the cellular tissue. A bevel which is too short applies itself too easily against the wall of the vein and leads the operator to believe that the needle has not passed in.

Other materials to be provided are:

A constricting band about 150 centimeters (4½ feet) long, or a piece of rubber tubing of medium caliber and 60 centimeters (2 feet) long and a hemostat.

Tincture of iodine and alcohol.

The wherewithal for a dry dressing.

If required also, a sterile glass tube to receive the blood, or a blood culture tube, or a receptacle of some sort, according to the purpose of the procedure.

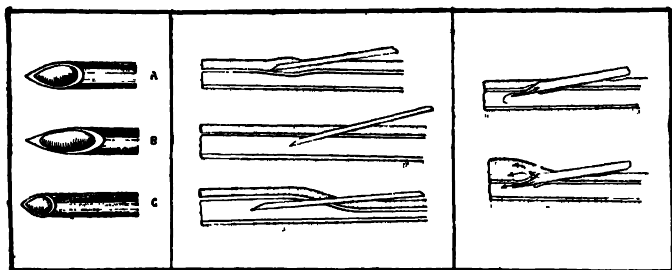


Fig. 138.—Vein puncture.—The needle and its introduction: *A*. Needle with proper bevel. *B*. Bevel too long. *C*. Bevel too short.—Middle illustration: The three stages in correct introduction of the needle.—Right-hand illustration: Drawback of too long a bevel; blood passes into the cellular tissue.

A glass syringe of a size suitable for the object intended.

Preliminary Preparations.—The patient should be recumbent, with the back and head supported on pillows.

The operator selects the arm showing the most prominent veins or in which these vessels seem most convenient, preferably the left arm. The upper extremity must be in a position which will insure adequate immobility, in complete extension, so as to reduce the mobility of the veins over the subjacent tissue layers.

To render the veins prominent, the venous circulation should be arrested above the site of puncture, the arterial blood being, however, still allowed to enter the forearm. This is done by applying a circular constricting band four or five fingerbreadths above the intended puncture.

The area selected should be painted with tincture of iodine, which is to be removed with a little alcohol just before the puncture is made.

The Constricting Band.—The rubber band, after being passed behind the arm, should be brought forward and its ends held firmly on a stretch by the nurse's hands. Or, the rubber tube may be wrapped around the arm and its ends brought together on the side and fastened with the hemostat.

When the band is to be removed, the nurse merely relaxes the tension or the operator removes the hemostat, when the band or tube will come off easily without jerking and without contaminating the operative field.

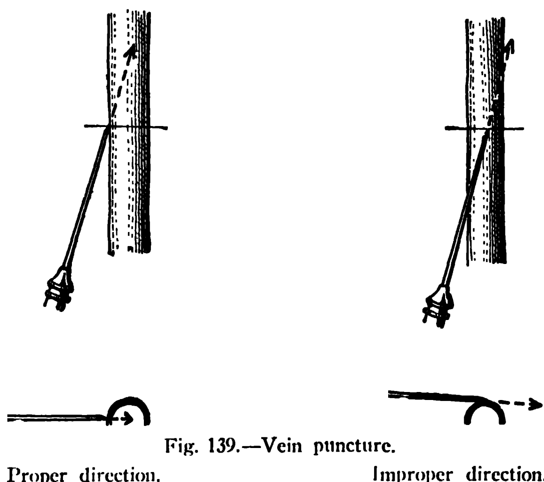


Fig. 139.—Vein puncture.

Proper direction. Improper direction.

Selection of the Vein.—All the subcutaneous veins are suitable, provided they are readily accessible and are of sufficient size. The most conspicuous veins are not always the best for the purpose; the very superficial subdermal venules, which attract attention by reason of their blue color, are generally very narrow, and the needle either misses them or pierces both their walls. Those veins should be selected which are made most prominent by the constriction of the arm. Immersion of the arm in hot water will frequently bring invisible veins into relief.

In the lower limb, the internal saphenous vein may be selected. In the upper extremity, there are sometimes numerous veins subject to choice on the dorsum of the hand, the lateral parts of the forearm, the bend of the elbow or the lower portion or the arm. As a rule,

the puncture is made in one of the veins at the elbow because these veins are clearly visible, rather large and can move but little when the arm is in complete extension; the median cephalic is indicated for the same reasons that make it preferable in venesection.

The degree to which the vein is fixed in the cellular tissue is often more important than the size of the vessel; the thickness or thinness of the overlying skin is also to be considered. Often it is easier to get into a small, thin vein at the elbow than in a vein three or four times larger on the back of the hand.

The Separate Needle Procedure.—In making the puncture, the needle should be held like a pen, with the mesial fingers of the right hand bracing the latter against the patient's arm. The left hand should hold the skin on a stretch, while the thumb and forefinger of the right hand guide the insertion of the needle. The chief knack in the procedure consists in puncturing the vein obliquely, with the needle directed from the laterally situated soft tissues toward vein; in other words, the puncture is made practically at a point lateral to the vein; the needle thus necessarily encounters the vein which it is to enter. The introduction should be carried out by advancing the joints of the fingers rather than the hand itself. The point of the needle should be pushed upward in the vein from the point of entrance.

As soon as the blood flows from the butt of the needle, the left hand connects with it the rubber tube or syringe to collect the blood.

The Syringe Procedure.—The operator is much better able to control the needle by holding a syringe to which the needle is already attached than by holding the detached needle.

The needle should always be introduced with its bevel below, and care should be taken to see that the position of the bevel bears a proper relation to the scale on the syringe.

Four details are essential for a successful introduction of the needle:

1. The syringe must rest on the palmar surface of the right hand, which forms a broad cushion against which the thumb fixes the barrel of the syringe.

2. To possess accurate control of the movements of the hand and of the syringe, and to avoid all false motion and jerking, the back of each of the four fingers should rest on the patient's arm.

3. The skin should be made tense with the left hand, to avoid its folding ahead of the advancing needle-point.

4. The puncture of the vein should be made in two stages: (*a*) Penetration of the skin. (*b*) Penetration into the vein.

Penetration of the skin should be effected directly, somewhat laterally to and above the vein, with the needle slightly tilted. Downward pressure by the right hand depresses the vein before the needle-point, so that a slight oblique thrust is sufficient to make the bevel enter the lumen of the vessel. At this juncture, as soon as the sen-

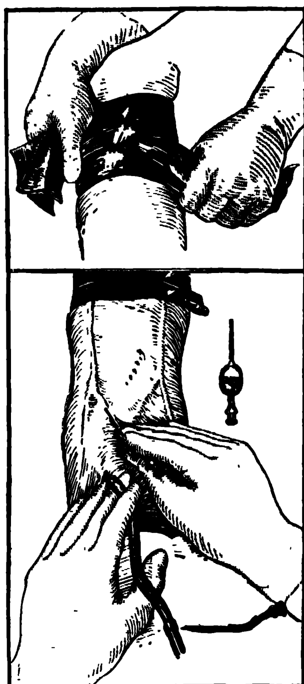


Fig. 140.—The separate needle procedure.

Above is shown the manner of holding the constricting band. Below, the physician's left hand is seen stretching the skin, while the thumb and forefinger of the right hand guide the introduction of the needle (*Stokes*).

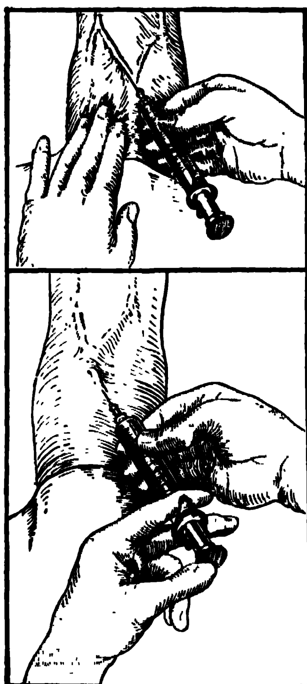


Fig. 141.—The syringe procedure.

Above is shown the introduction of the needle, the physician's left hand stretching the skin and the right hand pushing in the syringe with the needle attached. Below, the operator's left hand is shown pushing home the plunger of the syringe, while the right hand, motionless, holds the needle in position.

sation of having passed through the wall of the vein has been felt, the pressure of the right hand against the patient's arm is increased in order that the needle may travel horizontally along the vein.

As the needle advances, the tension on the skin by the left hand is lessened. The broad base by which the right hand, holding the syringe, rests on the patient's arm, insures firm manipulation of the instrument and prevents any false movement and perforation of the opposite wall of the vein. It is very important to push the bevelled portion of the needle to a point sufficiently far from that of entrance into the vein when an injection is to be made.

The passage of the needle into the lumen of the vein is heralded by a flow of blood into the syringe.

Complications.—If the needle has been inserted but the blood fails to appear:

1. Lower the point of the needle without advancing it any further; the bevel may have been occluded by contact with the wall of the vein.
2. Feel for the point of the needle with the free hand; if it is still above the vein, this fact will thus be ascertained.
3. If the syringe is being used, turn the plunger in the barrel, meanwhile withdrawing it slightly; the plunger may be caught.
4. If the point of the needle cannot be felt above the vein, it should be drawn back slightly; if it has passed through the opposite wall of the vessel it will come out of it with a perceptible jerk, and should then be reinserted in a higher position, pressure meanwhile being made on the arm.
5. If this maneuver proves ineffective, withdraw the needle point up to the skin puncture and reintroduce it after palpating the vein.
6. If this second attempt fails, take out the needle completely and reinsert it only after making sure that the bevel on it is satisfactory and that the needle is not blocked.
7. It is quite inexcusable to inject a little of the fluid in order to find out whether the needle is or is not in the vein.

After-care.—The puncture having been concluded, the needle is quickly withdrawn, light pressure made on the site of puncture for a few moments, and a little tincture of iodine applied. No dressing is required.

III.—INTRAVENOUS INJECTIONS.

The intravenous route is the route of choice when a drug is to be made to act on the system rapidly.

Indications.—The use of intravenous injections is steadily increasing. To mention only the commonest forms of intravenous treatment, we have: The injection of quinine salts in pernicious malaria; of mercurial and arsenical salts in syphilis; of salt solution in copious

hemorrhage; of collargol in blood infections, and of antidiphtheritic serum in malignant diphtheria.

Armamentarium.—In addition to the articles required for vein puncture, intravenous injection calls for the instruments used in injections in general.

(*a*) An all-glass syringe of 1 to 5 c.c. capacity for injections of small amounts of solution (*e.g.*, intravenous mercurial injections).

(*b*) An all-glass syringe of 10 to 20 c.c. capacity, or even larger, for injections of medium bulk (*e.g.*, intravenous injection of neoarsphenamin).

Syringes with excentric nozzles are available which greatly facilitate the collection of blood from the veins as well as the intravenous injections.

(*c*) A fountain syringe or transfusion receptacle for injections of larger volumes of fluid, such as 250 c.c. (8 ounces) or more (*e.g.*, injections of physiologic salt solution, glucose solution, etc.).

Preliminary Preparations.—These are the same as in vein puncture. Care should first be taken to see that the nozzle of the syringe and the needle fit perfectly. In the case of small syringes the needle is fitted directly onto the syringe. With the larger syringes, connection is made through an intermediate section. In the case of fountain syringes, a connecting rubber tube provided with a metallic end-piece fitting tightly into the needle is required.

With any of these devices, care should be taken, by projection of a few drops of the fluid into the air, to drive out any air bubbles that may be present in the syringe or rubber tubing.

The receptacle (whether an ordinary syringe or a fountain syringe), the end-piece and the rubber tube should, of course, be sterilized, either in the autoclave or by prolonged boiling.

Technic.—The procedure is exactly the same as for vein puncture. The vein having been entered, and the operator being certain that the end of the needle is quite free in the lumen of the vessel, the syringe or rubber tube is connected with the needle. The part should be held with the right hand, while the nurse is removing completely the constricting band. The vein then subsides, but if the patient has remained quiet, the needle will still be in good position.

The injection should be made slowly if a medium amount of fluid is being administered, and at a low pressure—20 to 50 centimeters (8 to 20 inches)—if the injection is being given with the fountain syringe.

Complications.—An intravenous injection is wholly painless, easily administered, without any resistance; it does not cause any local swelling. Notice that the fluid was being injected outside of the vein

would be given through the pain experienced by the patient, a perceptible resistance to the injection, and the formation of an edematous swelling at the point of injection. Under these conditions the injection should be discontinued at once, part of the fluid injected made to exude by pressure, local massage carried out to distribute the fluid over a larger area and a pressure dressing applied.

IV.—VENESECTION.

Instruments Required.—1. A sterile, *sharp* lancet or small ordinary scalpel.

2. A receptacle for the blood, if possible graduated with circular lines (pallet, bowl or jar).

3. A ligating band about 1.5 meters (5 feet) long, made of cloth, gauze or flannel, or a rubber tube of medium caliber and about 60 centimeters (2 feet) long and a hemostat.

4. Some tincture of iodine and a little alcohol.

5. The materials required for a dry dressing: Sterile gauze, absorbent cotton, and a bandage.

Selection of the Vein.—Any noticeable vein of sufficient size may be used.

The vein of choice is the median cephalic at the elbow; exceptionally, the internal saphenous may be selected, and very exceptionally, the external jugular.

Preliminary Preparations.—The patient should be recumbent on the side of the bed corresponding to that on which the bleeding is to be carried out, so that the arm may readily be extended beyond the bed. This side of the bed should be covered with a folded sheet, large napkin, or some impervious material, such as oilcloth. Above the vein selected is placed a circular constricting band (rubber tube fastened with a hemostat or a bandage fastened like a tourniquet), sufficiently tight to stop the venous circulation. Tincture of iodine is applied and one minute later the area washed with a pledget moistened with alcohol.

Technic.—1. Place the patient's arm in the extended position, with the elbow projecting beyond the bed, over the receptacle intended to receive the blood.

2. Hold the elbow in the palm of the left hand, with the thumb over the lower portion of the vein, so that the skin at the bend of the elbow shall be placed on a stretch and the vein appear in it as a conspicuous and prominent cord.

3. Hold the lancet or scalpel, with its cutting edge directed upward, between the thumb and forefinger of the right hand, the ulnar border of the hand resting on the forearm of the patient.

4. Puncture the outer aspect of the vein with the point of the



Fig. 142.—Venesection at the bend of the elbow, from the median cephalic vein.

The left thumb holds down the vein, which is about to be punctured with the lancet held between the thumb and forefinger of the right hand.

instrument, the point being directed at right angles to the axis of the vessel; complete the section of the vein by transfixion.

5. The blood spurts with more or less force, describing a parabolic curve; the receptacle is directed so as to receive it. When the jet of blood tends to subside, some object is placed in the hand of

the patient, who is directed to squeeze it intermittently and rhythmically, the muscular contractions favoring the outflow of the blood.

6. When the amount collected is deemed sufficient (100 to 1000 c.c.—3 to 30 ounces), the constricting band is removed by loosening the hemostat or untying the knot. A piece of sterile gauze is placed over the wound. The part is cleansed with alcohol, and a somewhat firm dressing applied.

Complications.—1. DIFFICULTY IN OBTAINING BLOOD:

(a) *On account of the adipose condition of the patient* and the delicacy of his veins or because of vascular anomalies: A visible, prominent and accessible vein should be sought.

(b) *On account of phlebosclerosis;* the point of the needle slips along the thickened wall of the vein: With a sharp point and by puncturing the outer aspect of the vein, this slight difficulty is readily overcome.

(c) *On account of lack of parallelism between the openings in the skin and the vein:* The necessary relationship should be re-established by suitable traction.

(d) *On account of an insufficiently tight constricting band:* Tighten it.

(e) *On account of occlusion of the wound by a small mass of fat:* Broaden the wound by traction.

2. GENERAL DISTURBANCES.—The emotion entailed, the sight of blood, or a too copious venesection may exceptionally bring on: Cold sweat, faintness, vomiting and even collapse.

These complications may be avoided by keeping the patient's head low, turning the head away from the local procedure, and if need be administering a stimulant beforehand.

They are treated during the procedure by lowering the head and giving a diffusible stimulant, such as camphor in oil, caffeine, syrup of ether (2 per cent.) or ammonium acetate. (See *Diffusible Stimulants.*)

3. LOCAL COMPLICATIONS:

(*a*) IMMEDIATE.—*Injury to the brachial artery.*—This can result only from a seriously faulty technic, WHICH SHOULD NOT BE ALLOWED TO OCCUR. Injury to the brachial artery would necessitate ligation of both ends of the vessel; otherwise serious hemorrhage would take place, possibly followed by the formation of an arteriovenous aneurism.

(*b*) SUBSEQUENT.—(1) *Interstitial hemorrhage in the cellular tissue* of the region with the formation of an ecchymotic area of varying extent. This complication is in no wise serious, and disappears under the dressing.

(2) *Lymphangitis or phlebitis:* The procedure, carried out under proper aseptic conditions, should not give rise to these complications.

The above enumeration of possible complications should not cause one to lost sight of the fact that venesection is an easy and harmless procedure.

Indications.—The effects of bleeding may be referred to two modes of action: *Depletion* and *detoxication.*

(a) *Depletion.*—It combats plethora, diminishes the volume of the blood, reduces a dangerous tension of the right heart, facilitates the contraction of the walls of the heart-cavities, alleviates the circulation, and contributes to the restoration of circulatory balance, sometimes almost immediately.

(b) *Detoxication.*—It removes from the system almost instantly a notable amount of toxic material.

[Petersen and Levinson have pointed out that, in addition to the above effects, venesection leads to leukocytosis, altered blood coagulability, hyperglycemia, mobilization of antibodies, and alteration and dispersion of the serum colloids—all these demonstrating that bleeding actually constitutes a form of protein therapy.—Tr.].

It is indicated particularly in the following conditions:

Heart disturbances with venous stasis, cyanosis and threatening asphyxia.

Lung conditions associated with a tendency to cardiac inadequacy and asphyxia (acute edema of the lungs, congestive pneumonia, very extensive lung congestions, etc.).

Heart complications in pregnancy.

Uremia and *eclampsia.*

Cerebral hemorrhage; apoplexy.

Very high and ominous *blood-pressure* in nephritics.

Marked plethora with threatening lung congestion and very high blood-pressure.

Toxic blood conditions (poisoning by carbon monoxide, illuminating gas, war gases, etc.).

V.—BLOOD TRANSFUSION.

This procedure has become one of marked simplicity since the introduction of the citrate method of transfusion, the addition of sodium citrate preventing coagulation of the blood while it is being transferred from the donor to the recipient.

Indications and Contraindications.—The indications for transfusion may be divided into four groups:

1. Hemorrhage.
2. Pernicious anemia and leukemia.
3. Pre- and post-operative transfusion.
4. Septicemia.

1. Hemorrhage.—Bleeding in hemophilia affords a most satisfactory field for transfusion. It appears that in childhood the hemophiliac tendency can be completely and permanently overcome by a single transfusion of blood. The most striking results are obtained in melena of the newborn. These infants are generally brought to the hospital on the second or third day after birth, almost completely exsanguinated. A resident should at once visit the mother and obtain from her 100 c.c. (3⅓ ounces) of citrated blood. Blood matching is never necessary, as the blood of the mother never breaks down the erythrocytes of the newborn child. The blood is injected through a fine cannula into the median cephalic vein of the infant; the bleeding stops at once in the majority of cases and the child develops normally thereafter.

The results in purpura are by no means as satisfactory as those obtained in hemophilia.

Intestinal hemorrhage is sometimes so alarming as to demand immediate transfusion. If the hemorrhage is due to gastric ulcer, the transfusion should follow the operation that is carried out to prevent recurrence of the hemorrhage.

Post-operative hemorrhages following operations on the kidney, bladder, stomach, etc., are frequently checked by transfusion without the need of another operation.

2. Blood Disorders.—Lasting cure of pernicious anemia by blood transfusion cannot be hoped for. Yet life may be prolonged and the rapid progress of the disease temporarily arrested by repeated transfusions.

In primary or secondary anemia, very good results are frequently obtained.

3. Pre- and Post-Operative Transfusion.—Transfusion as a preoperative measure should be resorted to very often. Patients weakened by prolonged illness withstand an extensive operation better if they have been given a blood transfusion on the day before the operation. Transfusion will likewise hasten convalescence in a debilitated patient after an operation.

4. Septicemia.—The very acute forms of septicemia do not benefit from blood transfusion; the procedure might be extensively used, however, in the subacute and chronic forms.

Transfusion is also indicated in cases of poisoning by carbon monoxide.

Preliminary Preparations.—*Choice of the Donor.*—The choice of the donor is governed by the knowledge of the incompatibility in certain bloods from the same species. As is well known, the plasma of certain subjects first agglutinates, then causes hemolysis of the red blood

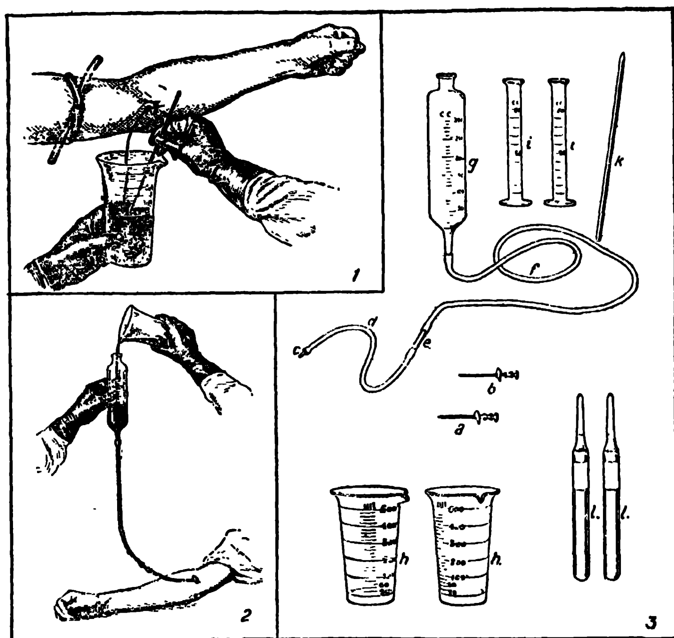


Fig. 143.—Technic of and instruments for blood transfusion.

l, l, glass ampules each containing 50 c.c. of a sterile 2.5 per cent. solution of sodium citrate; *h,* two large glass graduates, each of 500 c.c. capacity; *i, i,* two graduated cylinders, each of 50 c.c. capacity; *k,* glass rod; *g,* graduated container for arsphenamin injections; *a* and *b,* two cannulas, one of large and the other of medium caliber (*Richard Lewisohn*).

corpuscles of other individuals of the same species, sometimes even when they are blood relations.

The patient into whom there is being transfused blood which is hemolysed in his own organism either succumbs at once or develops a hemoglobinuria with acute nephritis which is sometimes fatal.

The principle underlying the tests intended to detect blood incompatibility is as follows: For a transfusion of more than 100 cubic centimeters *one must accept only a donor whose red blood corpuscles are not agglutinated* in vitro *by the serum of the recipient,* except in an extreme emergency which allows no time for making tests for blood incompatibility.

For selecting a suitable donor, there are certain simply and quickly performed tests based on the following principle: On a glass slide are mixed one drop of serum and one drop of blood taken from two different persons; note is taken of whether agglutination of the red corpuscles does or does not occur. This phenomenon is visible to the naked eye in less than five minutes. There is thus required neither laboratory, incubator, nor microscope (E. Jeanbrau).

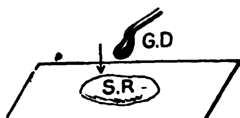
This test for agglutination may be made either directly or indirectly.

The *direct test* consists of testing the blood of volunteer donors against the serum of the recipient.

The *indirect test* (Moss-Vincent) consists in determining the agglutinative properties of the intended recipient, then selecting a donor whose blood will not be agglutinated by that of the patient who is to undergo the transfusion.

J. Abadie has admirably summarized, in *Presse médicale,* this preliminary test for blood incompatibility from the reports of Jeanbrau and Pauchet.

From each *donor* under examination a drop of blood is obtained by pricking the finger or the ear lobe and transferred at the end of a glass rod onto the drop of the recipient's serum on the slide (upon which the name of the donor should be written).



If there is no agglutination, transfusion can be carried out; if there is agglutination, the donor is incompatible.

Bécart's Method (shorter).

Clean, sterile watch glasses are used—two for each subject, as well for the recipient as for the donor.

For each subject (the recipient and each donor) are prepared:





Blood + sodium citrate = suspension of blood corpuscles = G.

Blood + distilled water (laking) = diluted serum = S.

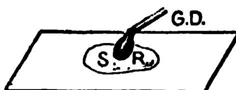
The following tests are now made:

The *essential, sufficient test,* performed on a slide: Mix one drop of the donor's G with one drop of the recipient's S.



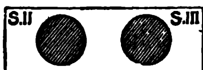
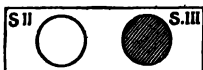
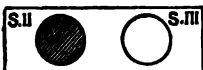
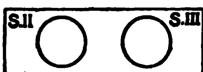
If there is no agglutination, the recipient and donor are compatible, and transfusion can be carried out.

Supplementary test: Mix one drop of recipient's G with one drop of donor's S.



If there is no agglutination, the recipient and donor belong to the same group—a still greater warranty of safety.

The following different eventualities are encountered, according to whether:

The RECIPIENT is in group:		The DONOR is in group:
I. *Universal recipient.*		I. *Cannot be used with any recipient* (hence, to be rejected).
II. Incompatible with a donor in group III.		II. Incompatible with a recipient in group III.
III. Incompatible with a donor in group II.		III. Incompatible with a recipient in group II.
IV. Incompatible with all donors. *Transfusion impossible.*		IV. *A universal donor.*

According to Moss's table, in which
0 = No agglutination; compatibility.
+ = Agglutination; incompatibility.

S.R. \ G.D.	1	2	3	4
1	0	0	0	0
2	+	0	+	0
3	+	+	0	0
4	+	+	+	0

There are blood incompatibilities, sometimes termed "humoral antipathies," which the agglutination tests cannot disclose. These tests must therefore be checked by an *"in vivo"* test, an actual biologic reaction, by contrast with the preceding tests which may be termed hematologic.

This test, which is known as Lindemann's test, consists in beginning the transfusion very slowly, interrupting it about every twenty seconds, and questioning the patient as to how he feels. If he experiences unpleasant sensations of increasing intensity, such as lumbar pain, pain in the abdomen or chest, dyspnea, precordial distress, or tingling in the extremities, the transfusion is at once stopped: The blood has been shown to be unsuitable.

This test, indeed, constitutes the only precaution to be taken in cases of extreme urgency when one is compelled to accept the first donor who volunteers for the purpose (E. Jeanbrau).

The areas selected should be cleansed with soap and water, and tincture of iodine applied.

The patients, including the donor, should be in recumbency with the arm extended as for intravenous puncture.

Lewisohn's Technic.—There are five steps in the procedure:

1. Preparation of the donor.
2. Preparation of the recipient or donee.
3. Withdrawal of the blood.
4. The transfusion proper.
5. Dressing, hemostasis, and suture if required.

Preparation of the Donor.—It is well to have him take a cup of coffee or give him a hypodermic injection of caffeine or adrenalin to raise his blood-pressure, especially if he is of the nervous type.

The operator personally applies the elastic constricting band at the root of the arm, drawing it just tight enough to stop the venous circulation without interrupting the arterial circulation; the radial pulse should be palpable.

Withdrawal of the Blood.—The donor's blood is obtained by vein puncture, preferably of the median cephalic or median basilic. The cannula used should be of sufficiently large caliber to allow the blood to flow rapidly; otherwise clotting may occur before the blood has mixed with the citrate solution.

In the majority of instances, the transfusion consists in the injection of 500 c.c. of blood.

The cylinder containing the citrate solution is emptied into one of the 50-c.c. graduated test-tubes.

Then 25 c.c. are poured into the large 500-c.c. graduate which is to receive the blood from the donor.

The blood is mixed with the citrate solution by stirring with a glass rod.

When 250 c.c. of blood have been collected, 25 c.c. of citrate solution are added to take up the 250 c.c. of blood remaining to be collected from the donor.

The desired quantity of blood having been obtained, the cannula is withdrawn and the site of puncture covered with gauze.

Preparation of the Recipient.—The introduction of the citrated blood into the recipient's circulation amounts simply to an intravenous injection.

In cases where the recipient's vein is clearly visible, puncture of the vein with a cannula of medium caliber is the procedure of choice. But in the majority of cases the patient is so anemic that exposure of the vein by incision is necessary. One may select at will a vein of the arm or the internal saphenous, which is easily discovered in front of the internal malleolus.

Sterile towels are arranged above and underneath the limb selected; local anesthesia of the skin and subcutaneous cellular tissue is next instituted, and an incision 4 or 5 centimeters (1⅗ to 2 inches) long then made over the vein.

Transfusion Proper.—The cannula is now connected with the arsphenamin tube containing 50 c.c. of physiologic salt solution, which is allowed to run in first and then followed immediately by the citrated blood.

The preliminary injection of a small amount of saline solution is advantageous in that it gets rid of the air in the rubber tube without wasting any of the donor's blood.

Suture.—When all of the blood has passed into the vein, the cannula is withdrawn and the skin wound closed with a few Michel clamps or silkworm gut sutures.

Complications.—Three precautions will obviate all untoward results: 1. Apply the bandage with the proper degree of tension. 2. Mix the blood well with the citrate solution, and see that the latter has not deteriorated. 3. Collect the blood quickly enough to avoid its clotting.

After-care.—The donor should be kept recumbent for a time and, if necessary, comforted with some alcoholic beverage.

* * *

TECHNIC OF ROBERT DANIS.—The best apparatus for blood transfusion appears to be, at the present time, that of Danis (Fig. 151), an *automatic* transfusing device by means of which transfusions can be carried out in one stage, in a closed vessel, the operation consisting simply of making two punctures and manipulating a syringe.

Transfusion thus performed may be made as copious or conducted as slowly as circumstances call for; it can be interrupted and resumed as often and as long as desired without any fear of clotting in the needles or the instrument itself.

The amount of blood in the device never exceeds 10 cubic centimeters; yet the transfusion is continuous.

As an anticoagulant Danis uses the Hustin solution (glucose, 50; sodium citrate, 4; water, 1000).

Essentially, the apparatus consists of a double-acting syringe of glass and metal.

The syringe plunger has a very thick stem, in order to reduce the air space around it, and slides through a perfectly airtight cap. By this arrangement one has two syringes in the same barrel, that below the plunger having a capacity of 20 c.c., and the other, of 10 c.c. The first cavity empties itself while the other is filling, and *vice versa.* These twin syringes are each connected by a rubber tube with a common section of the apparatus, known as the *mixer.*

This mixer is a small U-shaped tube carrying on its convex side a nozzle over which is adapted the needle to the donor.

A thin blade of nickel, of a width equalling the caliber of the needle, is fixed within this nozzle. It divides the needle into two longitudinal portions each communicating with one of the limbs of the mixer.

The needle is detachable and of the ordinary type.

The limb A of the mixer is connected by a rubber tube to the upper syringe, which has been previously filled with citrated glucose solution.

The limb B is connected with the lower syringe.

The needle, adapted to the mixer, is placed in the vein of the donor.

Upon withdrawing the plunger by pulling on the handle, the 10 c.c. of anticoagulant solution are driven into limb A and the corresponding half of the needle.

Simultaneously, however, the lower syringe is aspirating twice as much into limb B and the other half of the needle.

As a result of this mechanical principle, the citrated glucose solution which was flowing towards the vein is drawn to the other side

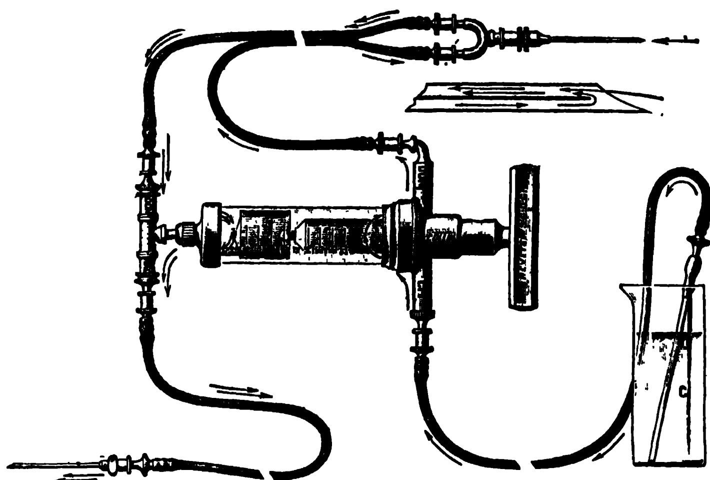


Fig. 151.—The Robert Danis transfusion apparatus.

of the partition, where it becomes intimately mixed with the 10 c.c. of blood which must also be sucked in to make up the 20 c.c. called for by the lower syringe.

The measuring off of the anticoagulant is as accurate as is possible, and not a drop of it is lost in the vein.

The action of the plunger drives the blood automatically toward the patient's vein and also renews the supply of glucose solution.

The apparatus is completely sterilizable and of relatively small size.

It may be carried about, ready for use, in an air-tight box.

The one-stage method of transfusion has been criticized on the ground that it necessitates bringing the patient and donor together.

But when the operation is performed in a cleanly manner and with discretion, is this circumstance really so great a drawback?

Besides, if, for any reason, it were impossible to bring the two persons together, it would be sufficient to collect the incoagulable blood in a flask and reinject it by means of the pressure from a rubber bulb.

Under these circumstances, the mixer alone might, in a pinch, suffice for collecting the blood, without it being necessary to use the syringe.

VI.—PUNCTURE OF THE PERICARDIUM.

Indications.—The indication for this procedure is simple: Pericarditis with a pronounced effusion which is obstinate or recurrent.

Three methods may be employed in reaching the pericardium.

In one method, the needle passes *outside of* and in another *within* the mammary vessels, which are situated from 5 to 20 millimeters (1/5 to 4/5 inch) from the border of the sternum.

In the third method, the pericardium is reached by the epigastric route.

The fluid collects in the pericardium mainly below, posteriorly, and to the right, in the cardio-hepatic angle. The epigastric route, therefore, appears the most certain.

Instruments.—For exclusively diagnostic purposes, a long needle and a hypodermic syringe are sufficient. For therapeutic puncture, the *aspirating outfits* for thoracentesis, with the needles or trocars they include, may be resorted to.

Technic.—Puncture Outside of the Mammary Vessels.

The patient is in the semi-sitting posture on his bed.

The needle is introduced downward and inward in the fourth, or preferably, the fifth intercostal space, about 6 centimeters from the left border of the sternum.

When the needle has penetrated to a depth of about 1 centimeter (2/5 inch), the cock on the aspirator is opened and the needle pushed in further in the same direction; resistance is felt upon reaching the pericardium, and the needle is further inserted until the pericardial fluid appears.

If no fluid is obtained at a depth of 2½ centimeters (1 inch), the patient should be brought up into the complete sitting posture and inclined to the right, in which position the fluid will sometimes begin to flow.

If the needle comes in contact with the heart, notice of the fact is given by jerky movements of the needle, synchronous with the heart-beats, transmitted to the hand of the operator. In this contingency the needle should be withdrawn a little or completely removed.

When the evacuation is finished, the needle is quickly withdrawn after having pinched the skin around it between the thumb and forefinger.

Puncture Within the Mammary Vessels (Method of Delorme and Mignon) (an exceptional procedure).—At the left sternal border, *i.e.*, about 15 millimeters ($\frac{3}{5}$ inch) from the median line, a vertical incision 4 centimeters ($1\frac{3}{5}$ inches) long is made one fingerbreadth

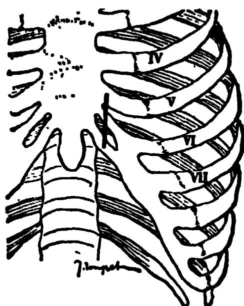


Fig. 152.—Delorme and Mignon method of pericardial paracentesis. The precostal soft tissues are incised.

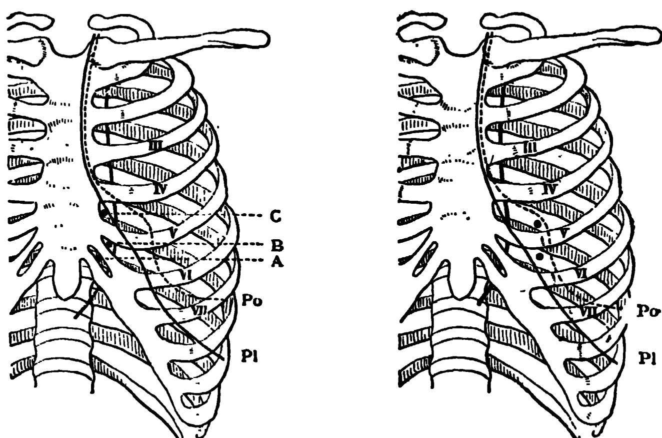
above the lower border of the fourth costal cartilage, exposing the sixth and fifth intercostal spaces. Preferably in the sixth interspace, exceptionally in the fifth or the fourth, the No. 2 needle of the Dieulafoy apparatus is slowly inserted at the sternal border, against which it rests. When the point is felt to have passed beyond the border of the sternum, which is generally 8 millimeters ($\frac{1}{3}$ inch) thick, the needle is tilted very obliquely from within outward. After having progressed 1 to 2 centimeters ($\frac{2}{5}$ to $\frac{4}{5}$ inch) in this direction, the needle can no longer encounter the margin of the pleura. It is then slightly raised and introduced obliquely inward and downward with a slow, continuous movement until the fluid appears.

Puncture by the Epigastric Route (Marfan's Method).—Puncture of the pericardium by the epigastric route is a procedure the technic of which has been so well worked out and which is so simple and harmless that it deserves to be availed of in every-day practice both

for diagnostic (exploratory puncture) and for therapeutic purposes (evacuation of fluid). Following is the procedure, as described by Blechmann ("La ponction épigastrique de Marfan," *Thèse de Paris,* 1912):

TECHNIC.—"The patient is in bed in the semi-sitting posture. The puncture may be preceded by local anesthesia. The left hand is placed upon the base of the thorax and the nail of the forefinger applied at the tip of the xiphoid appendix, which constitutes the required landmark.

"The small trocar of the Potain outfit or a lumbar puncture needle is introduced just *below the xiphoid appendix in the median line.* The



Figs. 153 and 154.—Points for pericardial puncture.

Within the mammary vessels, without penetrating the pleura. Outside of the mammary vessels and through the pleura.

needle is directed obliquely from below upwards, and during the first stage of its course, for a distance of 2 centimeters, it grazes, as it were, the posterior surface of the xiphoid; from the beginning of the procedure it is thus kept one-half fingerbreadth away from the peritoneum, which, furthermore, rapidly falls away toward the concave surface of the diaphragm.

"The needle is thus passed through the subperitoneal cellular tissue without coming in contact with the peritoneum, and after travelling for a variable distance, comes into relation with the sternal insertions of the diaphragm, passing through the hiatus thus formed in this muscle; the prepericardial cellular tissue of the anterior mediastinum and the subperitoneal tissue are in direct communication through

this hiatus. The retrosternal interstice should not be confused with the spaces of Larrey.

"While the trocar should at first be inserted in such a way as to stay as near as possible to the bony surface, this rule should not be applied to an exaggerated extent; otherwise, while seeking to obtain contact of the trocar with the posterior surface of the bone, there would be risk of penetrating, not into the pericardial cavity, but

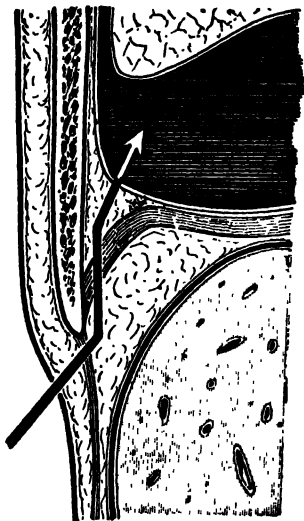


Fig. 155.—Course followed by the trocar in puncture beneath the xiphoid (*Blechmann*).

into the cellular tissue which separates the pericardial sac from the triangularis sterni muscle.

"Indeed, whereas the prepericardial space measures, above, 2 to 5 centimeters in depth, below, on the contrary, as is clearly to be seen in an anteroposterior section, it is only 1 centimeter deep.

"It is sufficient, therefore, to direct the trocar somewhat obliquely backward after it has travelled the first 2 centimeters of its course, for it to penetrate into the pericardium through its basal portion (Fig. 155).

"The base of the pericardium rests upon the convex surface of the diaphragm, to which it is adherent over an area varying from 9 to 11 centimeters in breadth and from 5 to 6 centimeters anteroposteriorly.

"This area of adhesion of the pericardium to the diaphragm presents, on the whole, an irregularly oval shape, the larger extremity of the oval being situated on the right and its long axis directed obliquely from behind forward and from right to left. It may also be compared to a spherical triangle with its three curved sides facing, respectively, anteriorly, to the right, and to the left. The anterior margin, convex forward, is very close to the sternocostal wall in the median line; at its left extremity, however, it is distant 3 to 5 centimeters from the sternocostal wall, and at its right extremity, 6 to 7 centimeters.



Fig. 156.—Pericardial puncture beneath the xiphoid.

"This last fact is of some significance, as will later appear. It is not absolutely necessary to introduce the needle exactly beneath the tip of the xiphoid appendix. In the course of seventeen punctures carried out on a single patient, the trocar was inserted slightly to the right or left of the tip of the xiphoid in order to spare the skin. If the puncture is thus started away from the midline, the needle should be rapidly brought back *toward the midline* [as the author has done, and likewise N. Fiessinger]. This precaution does away with the risk of injuring the fibers of the diaphragm, and furthermore, as we have just seen, while the anterior border of the pericardium is quite near the parietes in the median line, this distance increases considerably as soon as one leaves the median plane.

"Upon palpation of the infrasternal region the practitioner will note that the sternum and seventh rib join at a very acute angle. The bony prominences are in the way and the extremely serviceable

landmark constituted by the posterior surface of the xiphoid appendix is no longer available.

"Again, where the effusion is wholly posterior to the heart, it will be an easy matter, after having carefully followed the xiphoid for a distance of 2 centimeters in order to obviate all risk to the peritoneum, to direct the trocar definitely backward and upward to a more posterior part of the base of the pericardium.

"*Facts justifying the procedure.*—Researches on the cadaver, the knowledge derived from clinical experience and X-ray examinations, and operative findings have yielded a convincing combination of concordant evidence.

"*To meet the effusion directly, it must be sought in the region where it is collected to a maximum degree, viz.*, either in the cardiohepatic angle (Rotch's angle) or below the heart.

"Puncture in Rotch's angle, however, is an anterior puncture, attended with the difficulties and risks of such a procedure.

"Therefore the fluid should be sought *below the heart.*

"Between the tip of the xiphoid appendix and the pericardium there are no vessels nor pleural surfaces; the peritoneum is remote; the diaphragm, pushed downward by the effusion, presents itself of its own accord toward the point of the needle. The fluid, collected to a maximum degree in this location, *will have revealed its presence to aspiration* long before the needle can have grazed the heart.

"Here, then, is the proper point for pericardial puncture."

I have had no personal experience with pericardial puncture by the epigastric route in children. In the adult I have performed it nine times, successfully and without untoward results. For various reasons, however, such as an inwardly directed or elongated xiphoid, etc., I was led to select as the seat of election in the last 5 cases the right and left xiphocostal angles, the point of the puncturing instrument being directed toward the median line. The entire course of the needle, which is 7 or 8 centimeters when one starts from the tip of the xiphoid, was thus reduced to 4 or 5 centimeters. As instruments I used Potain's small trocar or Tuffier's lumbar puncture needle. In a case of pericarditis with extensive effusion, probably of tuberculous origin since the lymphocytes predominated, I injected after puncture, as Émile Weil and Loiseleur had done already, 300 cubic centimeters of air, without any noticeable untoward effect and apparently with extremely satisfactory clinical results.

Amount of Fluid to be Withdrawn.—As a rule, the amount of fluid withdrawn in pericardial effusion is not very large; the average

is 300 to 500 cubic centimeters (10 to 16 ounces), seldom 1 liter (32 ounces).

Untoward Events.—*Wounding of the pleura* should not, it would appear, lead to any complications.

Penetration of air into the pericardium has been reported by Aran and by Bouchut. This accident is, on the whole, devoid of serious significance and, indeed, it would even seem indicated systematically to favor its occurrence in some cases.

Sudden death has never yet been reported, to my knowledge, when the epigastric method has been used.

Wounding of the heart is the most dreaded accident; it is avoided by introducing the needle slowly, and, as a matter of fact, it is not always of grave significance. When the evacuation of fluid is completed the heart may approach and become scratched against the trocar without any serious results.

VII.—INTRACARDIAC INJECTIONS.

The indications for this procedure, which are rather exceptional, include serious collapse under anesthesia (general or spinal), post-hemorrhagic collapse, shock of pleural or peritoneal origin, etc. The number of successes obtained with it in such cases is not as yet very large, but the measure should be borne in mind in cases of acute, serious heart weakness.

The technic is very simple:

Disinfection of the skin with tincture of iodine.

Use a thin needle of 2 millimeters ($\frac{1}{12}$ inch) caliber and 8 to 10 centimeters ($3\frac{1}{5}$ to 4 inches) long.

Locate the fourth left costal interspace.

Insert the needle against the border of the sternum in order to avoid striking the left internal mammary artery.

Direct the needle slightly toward the median line, meanwhile exerting slight suction with the syringe, to a depth which varies according to the thickness of the connective tissue in the individual, *viz.*, from 3 to 5 centimeters ($1\frac{1}{5}$ to 2 inches). When all resistance ceases and blood fills the syringe, the needle is in the right ventricle.

Inject 0.5 to 1 c.c. (8 to 16 minims) of 1:1000 adrenalin solution.

If puncture into the left ventricle were desired, the procedure would consist simply of inserting the needle one fingerbreadth within the apex of the heart, in the fourth, fifth and even the sixth left costal interspace, with the needle directed upward and slightly inward.

A number of cases of "resuscitation" of the heart, obtained in this manner, are on record in medical literature. It seems worth bearing in mind, however, that some contradictory experimental results have been published. Bardier and Stillmunkes (*Soc. de biol.,* July 1, 1922), found that intravenous injection of adrenalin is capable of causing death by sudden arrest of the heart in fibrillation. This fatal "shock" might occur in any stage of anesthesia, either in animals (dog, cat) or in man.

VIII.—IMMOBILIZATION OF A LIMB AFFECTED WITH PHLEBITIS.

The treatment of phlebitis in the acute stage requires immobilization of the affected limb in an elevated position. Only after a period of complete apyrexia can the second stage of the treatment, *viz.,* kinesitherapy, be undertaken.

THE POSTERIOR SPLINT METHOD.

Before the world war the device used for immobilization in phlebitis was a wire gutter-splint, with different models for the right and left extremities. Other materials required were: Cotton, a piece of canvas or linen, bandages, a piece of fabric 6 meters (20 feet) long by 5 centimeters (2 inches) wide, and a few cushions.

Preliminary Preparations.—*Preparation of the Posterior Splint.*—The gutter-splint should be well padded with cotton within, and this padding should overlap on either side so that it can be folded over the limb. A pad of cotton should be placed at the Achilles tendon and another beneath the popliteal space. After this there is placed over the cotton a Scultetus dressing, consisting of a piece of canvas or linen of sufficient length and breadth to enclose the limb from the toes to the inguinal region. Over this fabric are placed cloth straps or compresses arranged transversely and overlapping so that one-half of the width of each strap is covered by the next.

Application of the Splint.—The limb is taken hold of gently and placed in the gutter-splint. In doing so, the palm of the hand is placed under the heel, avoiding contact with the tendo Achillis, and the leg is always lifted up very straight.

Immobilization.—This should be effected with the limb in good position, *i.e.,* with the foot at a right angle with the leg (the Achilles tendon resting on the pad), the leg straight, and the popliteal space supported by a pad to prevent hyperextension of the knee. For the

limb to be in good position one should be able, on looking along it, to see the anterior superior iliac spine, the outer border of the patella and the space between the first and second toes in the same straight line. The straps or compresses moistened with alcohol are then crossed over the limb and the canvas or linen, as well as the cotton, folded over the whole.

Finally, a bandage is applied around the splint and limb, sufficiently tight to immobilize the extremity in the desired position.

The apparatus should rest on a cushion sufficiently padded to raise the end of the limb 30 or 40 centimeters (12 to 16 inches) above the plane of the bed.

THE THOMAS SPLINT METHOD.

Materials Required.—A piece of canvas or linen, 1 meter (40 inches) wide and somewhat longer than the limb.

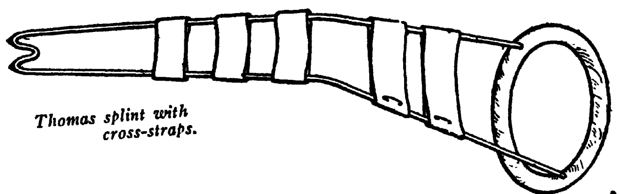
Straps 5 centimeters (2 inches) wide, long enough to go around the limb 1½ times at the various levels, and sufficiently numerous—about 2 dozen—to cover it from end to end with the straps overlapping like tiles on a roof. The straps intended to cover the thigh and calf should, of course, be longer than those for the foot or knee.

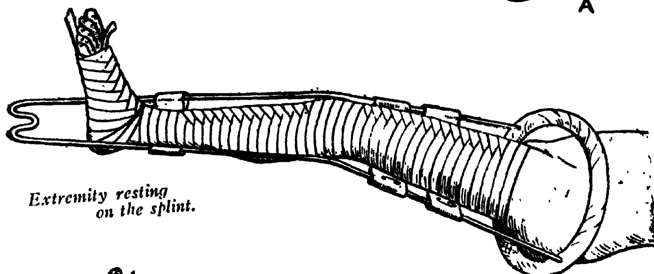
The straps are arranged over the piece of canvas, with the first one 8 or 10 centimeters (3 or 4 inches) from its upper edge, then the others in succession, one over the other down to a short distance from the lower edge of the canvas. Each strap should cover one-half of the width of the preceding one.

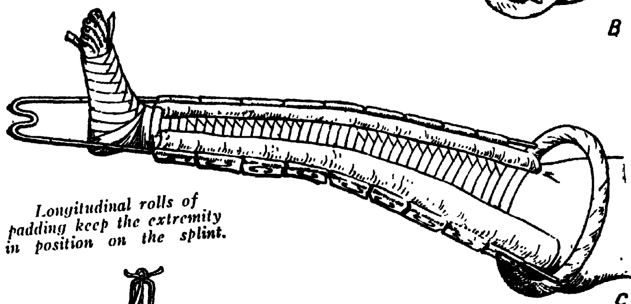
The Thomas splint for fractured thigh is preferable to the old gutter-splint of metallic lattice-work, as it permits of better observation of the phlebitic process as well as of better suspension. This splint should be slightly bent at the knee, and should be supplemented with the Sinclair supporting device. The latter consists of a rectangular iron frame which serves as a support for the Thomas splint and allows of suspension of the foot at a right angle.

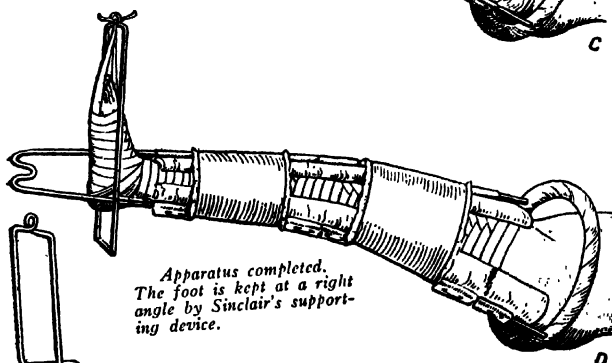
The limb should be supported in the Thomas splint by cross-straps made of two thicknesses of muslin or flannel and of the following sizes: Small straps, 40 by 12 centimeters (16 by 5 inches); large straps, 60 by 20 centimeters (24 by 8 inches). The cross-straps are fastened to the splint with safety-pins.

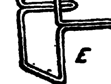
Application of the Splint.—The limb which is the seat of phlebitis should first be gently washed with warm water and soap. A little cotton should be placed between the toes. The physician then gently lifts up the limb and the nurse slips under it the Thomas splint with











Figs. 157 to 161.—Use of the Thomas splint to immobilize the lower extremity affected with phlebitis.

its cross-straps, over which rest the piece of canvas or linen and the Scultetus compresses.

Over the plantar and dorsal surfaces of the foot are placed the two extension straps, which need not be glued on. The Scultetus straps are applied from the distal end of the limb upwards. The physician takes hold of the outer end of the lowest strap while the nurse takes hold of the inner end of the same strap and places it on a stretch; the operator rolls this strap obliquely around the foot so that it ends on the inner aspect of the foot, thus helping to fix the extension straps on the foot and also carefully lifting up the excess at the end of the strap, so as not to have any folds; the assistant applies the inner end in the same manner so that it ends on the outer aspect of the leg. Over this first strap is placed the second in the same way, and the others in succession; all these straps overlap like the tiles of a roof. If the procedure has been carried out regularly, the edges of the straps are all parallel and form an angle of 45° with the axis of the limb; the pressure exerted by these straps is as firm and as regular as that afforded by a roller bandage. The straps may be loosened and tightened without causing the least displacement.

On either side of the limb are placed two long rolls of cotton intended to brace the limb against the splint; the whole—limb and cotton—is kept in the splint by a bandage covering all and extending the length of the apparatus or, more simply, by bandages over the lower portion of the leg and the lower portion of the thigh.

An ordinary pillow is placed under the patient's head. A handle is placed within his reach to enable him to lift himself up. The elevated position of the limb favors the return circulation, permits of avoiding venous stasis and reduces the edema.

Whenever the condition of the limb is to be examined, one has merely to take off the bandage and loosen the Scultetus straps, without in the least jarring or displacing the limb.

VI

THERAPEUTIC PROCEDURES RELATING TO THE RESPIRATORY TRACT.

I.—PROCEDURES APPLICABLE TO THE UPPER RESPIRATORY PASSAGES.[1]

I.—INHALATIONS.

Indications.—Inhalations have for their purpose to decongest the mucous membranes of the nasal cavities, pharynx, larynx and their

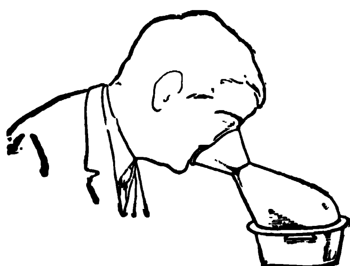


Fig. 162.—Apparatus and procedure in inhalation (*Laurens*).

accessory structures by means of warm vapors passing into all the cavities. They are used with advantage in acute coryza and in beginning sinusitis.

Apparatus.—There are available a number of practical inhalers which direct the vapors wholly toward the nose and mouth. If they are not at hand, one should not rest satisfied with simply leaning over a pan of boiling water with the head covered with a towel, but should use a bowl covered with a card-board cone from which the tip has been cut off. The bowl should be a sufficiently broad one. The eyes and upper part of the head must be excluded.

[1] [Most of the illustrations and many descriptions in this section are from the work of GEORGES LAURENS entitled *"Oto-rhino-laryngologie du praticien."* Paris: Masson et Cie., publ.].

For inhalation menthol solutions are frequently employed:

℞ Alcoholis .... 100 c.c. (f℥iiiss);
Mentholis .... 4 grams (ʒj). —S.

Position of the Patient.—The patient is seated in front of the table on which the inhaler is placed, closes his mouth and breathes through the outlet of the inhaler for four or five minutes.

The inhalations are repeated four or five times a day.

II.—CLEANSING OF THE NASAL CAVITIES.

Cleansing of the nasal cavities is carried out with warm, aseptic fluids. Two procedures are employed:

1. The *nasal bath*, which consists in introducing in the nose without pressure, and keeping it there for a time, a small amount of fluid.
2. *Nasal lavage* or the nasal douche.

THE NASAL BATH.—The nasal bath should be prescribed for the purpose of favorably influencing the nasal mucous membrane in certain mild forms of congestive rhinitis, catarrhal rhinitis or coryza.

Apparatus.—It is carried out with a special *pipette* [or "douche"]. A slightly warm (between 37 and 42° C.—98.6 and 105.8° F.), alkaline solution may be used, *e.g.*:

Sodium borate ...... 6 teaspoonfuls to the liter (quart) of water.
Sodium bicarbonate .. 4 " " " " " " "

The fluid used should always be normal saline solution, *i.e.*, a solution of 7.5 grams (2 teaspoonfuls) of salt in 1 liter (quart) of water. No antiseptics should ever be used, as they irritate the epithelium of the mucosa.

Technic.—The pipette is filled, the end opposite the nozzle which is to enter the nostril closed with the finger, the nozzle inserted into one of the nostrils, the head thrown back, and the flow of the fluid into the nose regulated with the finger. The patient breathes quietly through the mouth; the fluid remains in the nose without descending into the throat, on account of reflex contraction of the velum palati; this position is held for a half-minute. The third step of the procedure consists in bending the head forward so that the fluid may run out. The maneuver is repeated in each nostril alternately until the contents of the tumblerful of solution is exhausted.

NASAL LAVAGE.—**Indications.**—The nose should be irrigated only when it is unclean and in certain cases: 1. When there is present a *foreign body*. 2. When the nasal passages are filled with crusts (ozena) or with *purulent mucous material*. In the first instance, the irrigation will

exert a curative influence. The solution should be introduced through the nostril of the sound side, so that the stream of fluid will recoil, as it were, through the occluded nasal cavity and will expel the foreign body from behind forward.

In ozena, the lavage has for its purpose to rid the nose mechani-



Fig. 163.—Nasal pipette.

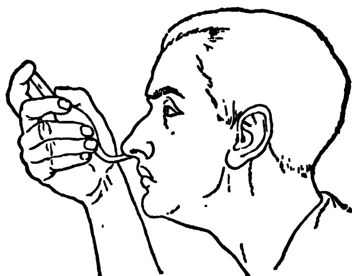


Fig. 165.—The nasal bath. Second step: Introduction of the pipette in the nostril.



Fig. 164.—The nasal bath. First step: Filling the pipette.



Fig. 166.—The nasal bath. Third step: The patient bends his head forward, causing the fluid to run out.

cally of the mucus or crusts which line its walls and to eliminate temporarily the unpleasant odor (Laurens).

Contraindications.—Lavage of the nose is absolutely contraindicated: 1. In all *acute nasal inflammations,* in which there would be danger of its causing infection of the ear and accessory sinuses. 2. In all cases of *nasal obstruction,* hypertrophic rhinitis and polyps.

Apparatus.—A fountain syringe of enamelled ware, elevated about 50 centimeters (20 inches) above the patient's head, is generally used;

an olive-shaped nozzle of glass, or simply a glass vaginal cannula with but one opening, is inserted in the end of the rubber tube.

The receptacle should be filled with tepid boiled water to which 1½ teaspoonfuls of salt or 1 tablespoonful of sodium borate to the liter (quart) has been added.

Technic.—The patient, seated at a table, with his head over a bowl, introduces the tip of the nozzle into one of his nostrils in such a way as to fill it completely. The nozzle should be directed horizontally from before backward in the same direction as the axis of the mouth, and not vertically from below upward; if the latter, incorrect direc-

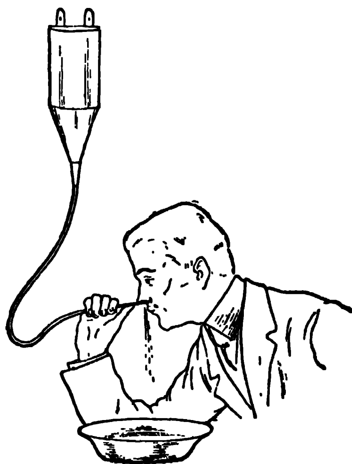


Fig. 167.—Nasal lavage. The nozzle should be directed horizontally from before backward, parallel to the floor of the nasal cavity.

tion were imparted to it, the stream of fluid, striking the ethmoidal region, would bring on a severe headache.

The nozzle should be held with the right hand.

The fluid will enter one nostril and leave through the opposite side.

Throughout the process of irrigation the subject should breathe quietly with his mouth open, without swallowing and without talking. With his left hand he should squeeze the rubber tubing from time to time to check the flow of solution and rest for a few moments.

When the irrigation is finished, the patient expels the solution remaining in the nose, not by blowing his nose with simultaneous pressure on both nostrils, but by blowing alternately through each nostril while the other is closed with a finger.

III.—USE OF OINTMENTS IN THE NOSE.

It is often useful to introduce into the nasal cavities ointments intended to exert a detergent effect on the mucous membrane and loosen crusts and mucus obstructing the nostrils.

One of the following ointments may be prescribed:

℞ Camphoræ,
vel Mentholis,
vel Eucalyptolis ....āā 0.2 gram (gr. iij);
Acidi borici .... 4 grams (ʒj);
Petrolati puri .... 20 grams (ʒv).
Fiant unguentum.

Procedure.—The patient takes up a little of the ointment on the end of the handle of a small spoon, places a piece of ointment of the size of a pea at the orifice of one nostril, closes the other nostril, draws



Fig. 168.—Inhalation of an ointment into the nose. One nostril is held closed, the other open.

the cheek and ala nasi backward with the forefinger, and sniffs up strongly so that the ointment will be drawn into the nasal cavity by the inward current of air.

IV.—SPRAYING OF FLUIDS INTO THE NOSE.

Instead of using ointments, one may order the spraying into the nasal cavities of medicated fluids calculated to exert a favorable influence on the mucous membrane and facilitate respiration by forming a species of dew or film on the surface of the membrane.

In this form of treatment a sterilizable spray apparatus of glass, with a detachable nozzle and easily cleaned, should be used.

Aqueous solutions, of which several examples are subjoined, may be employed, according to indications:

1. ℞ Sodii boratis .... 2 grams (ʒss);
Liquoris sodii chloridi physiologici ..... 100 c.c. (f℥iiiss).—S.

(Indicated in chronic coryza, with mucus, crusts, or mucopus, and for cleansing the nasal cavities.)

2. ℞ Cocainæ hydrochloridi .... 0.5 gram (gr. viiss);
Liquoris sodii chloridi physiologici ...... 50 c.c. (f℥iss).—S.

(Indicated in nasal obstruction in the course of violent acute coryza, and in acute sinusitis where the nasal occlusion prevents the inhalation from acting effectively. The cocaine solution with the addition of a few drops of 1: 1000 adrenalin hydrochloride—about 15 to 20 drops per 100 c.c. of cocaine solution—induces a vaso-constriction of the nasal mucosa and facilitates entrance of the inhaled vapor.)

3. ℞ Collargol .... 0.5 gram (gr. viiss);
Liquoris sodii chloridi physiologici ..... 50 c.c. (f℥iss).—M.

(This solution is indicated in coryza of long duration, with much suppuration.)

Or, *oily* solutions may be used, such as:

℞ Eucalyptolis .... 1 c.c. (♏xv);
Petrolati liquidi .... 100 c.c. (f℥iiiss).—S.

to exert a favorable influence on the mucous membrane in cases of chronic coryza.

The spraying should be carried out through both nostrils two or three times daily, with the spray directed from before backward.

V.—TREATMENT OF EPISTAXIS.

Epistaxis is always the result of ulceration of a small vessel in the mucous membrane. The cause is either *traumatic* or *symptomatic* of a *local lesion* (ulceration of the septum, nasal tumor) or of a *visceral lesion* (liver disease, nephritis, heart disease with high blood-pressure). Frequently epistaxis is due to a local varicose erosion of the septum. Elevate the tip of the nose with the index finger or insert a speculum and you will see a little ulceration of the size of a millet seed, almost always of digital causation, in the antero-inferior portion of the septum; around it radiates a little arterial clump made up of several small branches. Sometimes this ulceration shows a drop of blood; at other times it is covered with a dark crust, removal of which is sufficient to induce bleeding.

A. **Mild Hemorrhage.**—One of the following procedures should be availed of: *Pressure* or the application of some *hemostatic fluid.* Frequently, indeed, when the epistaxis is of congestive origin, as in nosebleed after meals or upon exposure to heat, *resting* for a while in

a cool room with the clothing about the neck loosened is enough to lead to spontaneous cessation of the bleeding.

The first active procedure to employ is *digital compression:* The ala is pressed strongly against the septum with the finger for several minutes.

One may also introduce into the nose a tampon of cotton or gauze of the size of a small walnut, previously moistened with a strong solution of antipyrin (equal parts by weight) or with full strength neutral hydrogen peroxide solution. (See Figs. 244 and 247, Vol. II.)

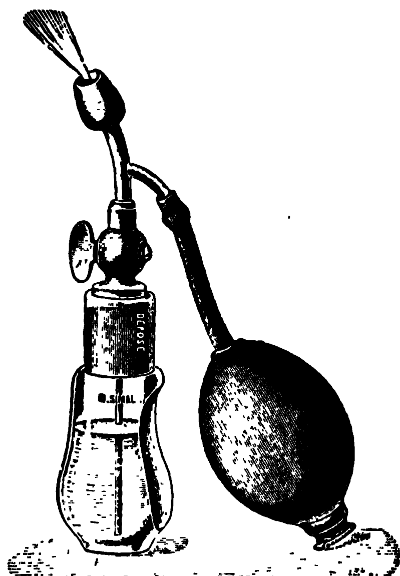


Fig. 169.—Nasal spray apparatus.

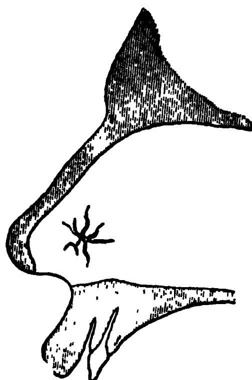


Fig. 170.—Clump of vessels representing the terminal ramifications of the sphenopalatine artery—the starting-point of the majority of cases of epistaxis.

B. **Severe Hemorrhage.**—The nasal cavities must first of all be freed of the clots with which they are filled; for this purpose the patient is made to blow out very strongly with alternate compression of the nostrils. At once a flow of fresh blood appears. Which side is bleeding? Usually it is the side from which oozing reappears as soon as the patient has blown his nose. Examination with a speculum would remove any doubt. Three measures may be used:

1. Introduction of Laurens's rubber bag.
2. Anterior packing.
3. Posterior packing (a makeshift).

The *nasal hemostatic bag of Laurens* is a small bag of thin rubber, 5 or 6 centimeters (2 or 2⅗ inches) long, ending in a rubber tube through which is introduced a small applicator wound with cotton in order not to puncture the rubber. This species of mandrin allows the physician to introduce the rubber bag in the nose in an absolutely horizontal direction, following the floor of the nose. As soon as all of the bag has passed in, the applicator is withdrawn. The bag is then inflated by blowing into the tube either with the mouth or with a small rubber bulb until the device is wedged in and cannot be withdrawn from the nose. Excessive distention should, however, be avoided on account of the resulting pain. The tube is then closed with a hemostat and a ligature applied to prevent deflation. If the blood continues to flow, the distention is insufficient and more air should be blown in. At the end of 12 to 18 hours the rubber bag is deflated and removed; meanwhile hemostasis has been effected.

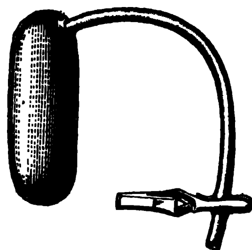


Fig. 171.—Laurens's nasal hemostatic bag.

(See also illustrations of these procedures in Vol. II—Figs. 242 to 247.)

Anterior packing should be preceded by evacuation of the clots. The speculum is inserted, and a strip of sterile gauze about 50 centimeters (20 inches) long and of the size of the little finger is introduced deeply, above and posteriorly, to the posterior wall with thin forceps. The gauze is packed in like an accordion so as completely to occlude the nasal cavity. It is removed 24 hours later, being moistened with hydrogen peroxide to detach it.

It is best to use gauze which has been soaked in some fatty or oily substance, such as oil in which a little gomenol has been mixed, then well wrung out. The insertion is thus easier and the withdrawal less painful and less productive of hemorrhage.

Posterior packing has only very limited indications, but may be necessary in case the other procedures fail. It entails marked danger of infection of the ears and sinuses.

The materials required to carry it out comprise a Nélaton rubber catheter, a pair of forceps, some gauze, a thick, long and strong silk thread and a tongue-depressor.

The *first step* consists in introducing the catheter horizontally backward along the nasal floor. Its extremity is gotten hold of in the pharynx with the forceps and brought forward out of the mouth.

One end of the silk thread is then fastened to the opening in the catheter and a gauze or cotton tampon of walnut size tied at its other end.

In the *second step,* the catheter is drawn out and the tampon pulled up to the posterior nares. In the *third step,* a tampon of gauze or cotton is fastened at the nostril between the two ends of the silk thread.

Arrest of bleeding takes place through the formation of clots in the nose. The tampons are removed after 36 hours. The tampon at the nostril should be detached first and that occluding the posterior nares then picked out with the index finger (Laurens).

Medical Treatment.—During a serious epistaxis the patient's general condition should be watched. He should be placed in recumbency with the head low, and external heat applied. Injections of normal saline solution (100 to 200 c.c.—3 to 6 ounces) should be given if the pulse is weak, but abstained from if the blood-pressure is high.

Resort may be had to fresh horse serum or antidiphtheritic serum, injected hypodermically to the amount of 30 c.c.

Instances of Epistaxis to be Let Alone.—In some instances epistaxis is a salutary event; it should be allowed to go unchecked in patients with *interstitial nephritis,* in heart cases with *high blood-pressure,* and in women with *suppressed menstruation.*

Prophylactic Treatment of Epistaxis.—The physician should take measures to prevent the recurrence of epistaxis by *general treatment* in heart disease, nephritis, etc., and by *local treatment* if the lesion is local.

The interior of the nose should be carefully inspected two or three days after recovery from epistaxis. In the antero-inferior portion of the septum there will be found either *bloody scabs,* which should be removed after being softened with petrolatum, or *varicose vessels.* The aim should be to destroy this hemorrhagic vascular focus by transforming it into cicatricial tissue through *cauterization.* For this purpose one may use either an applicator slightly moistened with:

℞ Acidi chromici .... 1 gram (gr. xv);
Aquæ destillatæ .... 2 c.c. (f℥ss).—S.

or a small bead of silver nitrate on the end of a probe. In the last-mentioned procedure the knobbed tip of a long probe is heated to redness and the silver nitrate stick then quickly applied to the probe 1 centimeter (⅖ inch) from its tip. The silver salt fuses, flows along the shaft of the probe and forms at its tip a droplet which soon solidifies and assumes a grayish color.

This bead of silver nitrate is applied over the affected area until a very thick whitish scab results. The mucus on the floor of the nose with

which the silver salt may have come in contact is then wiped out with a pledget of cotton.

The use of the silver nitrate should preferably be preceded by application of a little cotton moistened with 5 per cent. cocaine solution.

On the succeeding days the patient should draw up into his nose some plain petrolatum, morning and evening. He should be strongly enjoined to avoid any subsequent picking of the nose, which would tend to perpetuate the erosion of the mucous membrane.

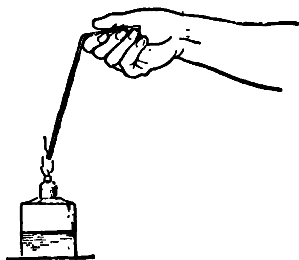


Fig. 172.—Prophylactic cauterization of the nose with silver nitrate in epistaxis (*Laurens*).

To destroy the small septal vessels from which the bleeding starts, silver nitrate is applied over them for a few seconds. Rather than insert into the nose a silver nitrate stick, which might be broken off by some unexpected movement on the part of the patient, it is preferable to heat to redness a long knob-tipped probe.

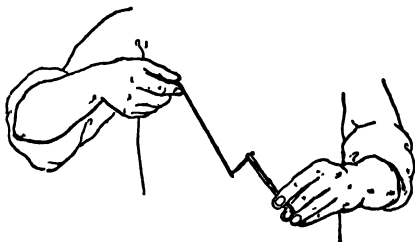


Fig. 173.—The probe is held by the right hand, while the left holds a stick of silver nitrate with forceps.

When the probe has reached a red heat, the stick is quickly applied to it 1 centimeter (⅖ inch) above its extremity. The silver nitrate fuses, flows along the probe, and forms a droplet at its tip. At once the stick is withdrawn, and care is taken not to move the right hand for a few seconds. The droplet solidifies and assumes a grayish color, thus affording a small bead of caustic at the tip of the probe. The operator waits until it has cooled, then applies it over the vessels responsible for the epistaxis.

VI.—INTRATRACHEAL INJECTIONS.

By G. Laurens, M.D.

This is a relatively new therapeutic procedure which is tending to become more generally used and will constitute, in the hands of the practitioner, a new weapon with which to combat suppurative conditions in the bronchi and lungs, and one more effectual, it seems, than the usual dosing by mouth with alcoholic and expectorant mixtures.

It has been generally recognized that among the routes of medication in disorders of the lower respiratory tract, the gastric, rectal and hypodermic routes all have many drawbacks. Experience has

shown that the simplest plan is to employ the direct route, *i.e.*, the tracheal tube, for injecting and introducing into the bronchial tree massive, and consequently effective, amounts of various drugs. How and under what circumstances is this procedure to be availed of? This is the question which it is necessary to answer in clear-cut fashion for the practitioner. It behooves the latter, indeed, to familiarize himself with this new method, study its technic and train himself in its execution, as it is capable of being of the greatest service to him in his daily work.

Indications.—Chronic bronchitis is the foremost indication for intratracheal injections, which permit of flooding the mucous membrane with a medicated fluid. Coughing and emphysematous subjects, inconvenienced by their copious expectoration, find their cough allayed and secretions diminished under the influence of these injections.

In a later stage, in bronchiectasis superimposed on bronchial catarrh, in which the patients expectorate large single amounts, recurring daily with disheartening regularity, of the characteristic "pea soup" sputum; in which fever, anorexia and loss of weight bear witness to the absorption of toxic materials from the bronchi and lungs, and in which the fetid character of the expectoration and of the breath poisons the patient and those in his vicinity, the balsamic oily layer injected through the tracheal tube is often observed, like a film of coal oil spread over the surface of a pool of water to destroy the mosquitoes, to coat the bronchial mucosa and disinfect and deodorize its products of excretion and fermentation. The general condition of the patient improves while the local disorder is benefitting from the treatment.

A somewhat uncommon complication in chest pathology, *viz.*, abscesses of the lung, all extrapulmonary purulent collections connected with the bronchi, and particularly pulmonary *gangrene*, a true "ozena of the lung" in its terrible malodor, derive the greatest benefit from the intratracheal injections. The gangrenous odor and the discharge of putrid material are very favorably influenced by the abrupt radical treatment consisting in a flood of oil spread over the surface of the necrotic areas.

Pulmonary tuberculosis in all its stages, including that of cavity formation, is said to be favorably influenced by this plan of treatment. which brings about a reduction of the cardinal symptoms, fever, cough, expectoration, and an improvement in the general condition.

Little will be said about the treatment of essential asthma by intratracheal injections of adrenalin. The method has not yet been

thoroughly worked out. At times exceptionally fortunate results from intratracheal injections have also resulted in acute and subacute pulmonary conditions.

Technic.—Two routes are open to the physician for introducing remedial fluids into the trachea and bronchi: (1) The natural or orolaryngeal route, which is the one most commonly employed. (2) The artificial or external route, which consists in reaching the trachea through a puncture made in the cervical region.

Each of these two procedures has its own special indications. If the patient is in a sufficiently good general condition to permit of his assisting the physician in the different steps of the procedure, and of his journeying to the office or hospital for treatment, there is no doubt that injection by the oral route is indicated. This is true of the majority of cases. If, however, one is dealing with a fatigued, depressed, asthenic, bedfast patient who is in a serious condition and cannot be anything other than passive, puncture of the trachea through the tissues of the neck for the injection of the remedial fluids is to be recommended.

1. Intratracheal Injections by the Ordinary or Orolaryngeal Route.—These may be carried out either under visual control, *i.e.*, with the laryngeal mirror, or without the assistance of vision. The first of these procedures will be described at length, as it is the most certain and most effective.

The apparatus required comprises a special 10-c.c. syringe ending in a long, curved cannula 15 to 20 centimeters (6 to 8 inches) long; a 2-c.c. laryngeal syringe for cocaine injection; 10 per cent. and 2 per cent. solutions of cocaine, and the medicinal fluid (5 and 10 per cent. gomenol in oil, 4 per cent. gomenol and guaiacol in oil, or 5 per cent. eucalyptol in oil). In pulmonary tuberculosis the use of 2 per cent. creosote in oil has been recommended; likewise the use of vaccines. In influenza intratracheal injections of antipneumococcus serum have been used.

The technic of laryngeal injection, like most catheterizations and the lesser operative procedures of each specialty, requires some training and the acquisition of a species of "knack." Two difficulties have to be mastered: 1. The defensive reflex of the pharyngeal and laryngeal mucous membranes. 2. Illumination of the larynx during the act of injection.

The physician should proceed as follows:

The injection should be made with the stomach empty and the fluid injected should be warm, to reduce the amount of coughing.

1. The pharynx is anesthetized in order to avoid the reflex nausea resulting from the contact of the laryngeal mirror. Exposing the pharynx with the tongue-depressor, the operator, with an applicator and cotton well moistened with 10 per cent. cocaine, applies the cocaine twice, at an interval of two minutes, over the uvula, soft

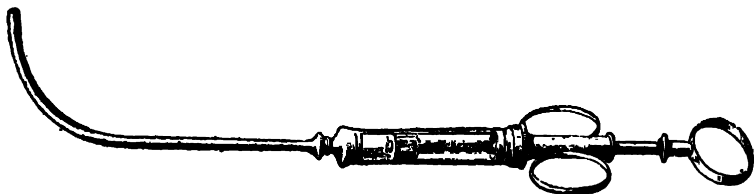


Fig. 174.—Laryngeal syringe.

palate, posterior pillars and pharyngeal wall. A different applicator should be used for the second application, for when covered with mucus, the first one would take up the cocaine less readily. Anesthesia is induced in five minutes. It should be complete, at least in the earlier sittings, to facilitate the second step. It becomes unnec-

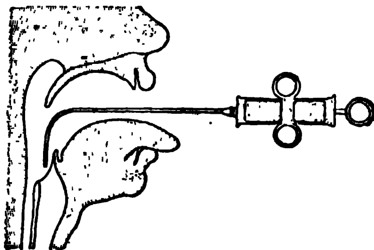


Fig. 175.—Institution of anesthesia of the larynx with the laryngeal syringe.

essary when the patient's reflex irritability has diminished and he is accustomed to the procedure.

2. The larynx is anesthetized in order to attenuate the cough reflex. The laryngeal syringe is filled with 2 c.c. of 2 per cent. cocaine solution. Both the physician and patient are seated in the proper position for laryngoscopy and the patient is requested to put out his tongue and hold it out of the mouth himself with a handkerchief, as in ordinary laryngoscopy. Throwing the light onto the pharyngeal wall with the head-mirror, the physician now places the laryngeal mirror against the soft palate with his left hand, while with

the right hand, holding the syringe by its three rings, with its barrel directed obliquely downward, he introduces the curved part of the cannula into the oral cavity, at equal distances from the palate and the tongue, taking care not to touch the latter structure. When the tip of the cannula has passed behind the base of the tongue, he raises his wrist in order to tilt the curved end of the cannula to a position above, then within, the superior orifice of the larynx. All these movements, executed very swiftly, recall the twist imparted to the catheter in urinary catheterization.

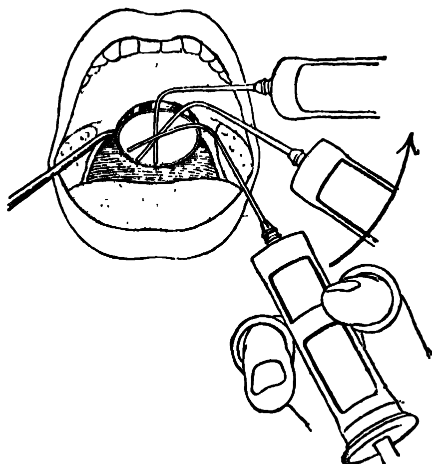


Fig. 176.—The successive stages in the introduction of the laryngeal syringe.

The contents of the syringe is then injected at one stroke into the cavity of the larynx. The difficulty consists in getting the tip of the syringe into the proper position above the vestibule, behind the epiglottis, without grazing the latter, for as soon as the cough reflex is brought into play, the larynx closes and is blocked. When the practitioner has succeeded in carrying out this step, *i.e.*, has seen the tip of the instrument enter and its contents discharged into the interior of the larynx, under visual control with the mirror, he will have mastered the most difficult part of intratracheal injection. He can acquire this mastery by repeated trials beforehand.

As soon as the liquid has dropped into the larynx, the patient is seized with a cough paroxysm of varying severity, which quiets down rather quickly, especially if he carries out properly the instructions

given him at this juncture, *viz.*, to close the mouth and take regular, deep breaths through the nose.

At the expiration of two minutes, the larynx is sufficiently insensitive to receive the medicinal injection.

3. With the aid of Rosenthal's special laryngeal syringe, filled with the medicated fluid, the preceding step is repeated, *i.e.*, under the control of the mirror, the physician passes into the larynx, and this time through the glottis, the tip of the syringe, requesting the patient to take a long, deep breath. Then, quickly, he injects at one stroke the contents of the syringe. A paroxysm of cough develops, which persists for a varying period. This "control cough" is the necessary proof that the liquid has entered the respiratory passages. No cough means no liquid in the bronchi; the liquid has gone

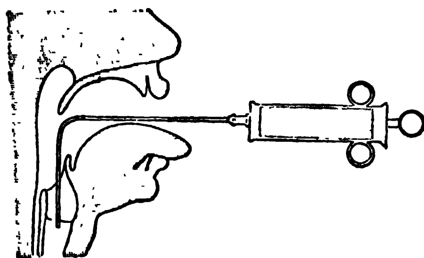


Fig. 177.—The tip of the nozzle intended for medicinal injections has passed through the glottis.

the wrong way, the patient having swallowed it through the esophagus and not received it in the trachea. The cough, we may add, is sometimes associated with the expectoration of sputum containing a portion of the oil injected and mucus or pus from the bronchi.

How much of the fluid is to be injected?

This depends on the tolerance established in the individual patient, *i.e.*, upon the reaction following the injection. At first, 2 or 3 c.c. should be injected; at the second sitting, 5 c.c.; 10 and even 20 c.c. are then rapidly reached by the fourth or the fifth sitting. One-half the ordinary concentration of the medicinal agent in the oil should be used at the early sittings; thus, in the case of a solution of gomenol in oil, the 5 per cent. solution should be used at first and the 10 per cent. solution reached at the third or the fourth treatment.

The injections should be given daily and in series of 10, with intervening periods of five days.

Have any untoward results been reported? Aside from trauma to the larynx due to faulty technic, congestive attacks and occasion-

ally hemoptysis are stated to have been observed in consumptives. These are, however, exceptional cases.

Mendel and Cantonnet have described a greatly simplified form of intratracheal injection. No illuminating mirror is used, but simply a 5-c.c. syringe the contents of which is injected into the *pharynx* in the following way: The physician drawing the patient's tongue strongly out of the mouth, carries out the injection, empties the syringe and holds the tongue out as long as possible, meanwhile instructing the patient to take five or six deep breaths. Any attempt on the part of the patient to draw the tongue back into the mouth must be strongly resisted, and not rarely the frenum is later found to have been cut through by the incisors.

This procedure is, to be sure, very simple, but that it yields results equal to those of the preceding method does not seem to have been demonstrated to the satisfaction of the laryngologists. When the injection into the pharynx is made in this procedure, it sometimes happens that fluid follows three different paths—esophageal, tracheal and buccal; a part of the injected fluid is swallowed, another portion properly inhaled, and the remainder expectorated.

Nothing like this occurs with the injection made under the control of the mirror, in which case all of the fluid passes into the bronchi. Furthermore, the approved method is absolutely aseptic, while the pharyngeal injection appears septic and seems to carry all the mucus of the mouth and pharynx down into the bronchial tree.

2. **Intratracheal Injections by the Cricothyroid Route.**—Where the patient cannot be subjected, for the reasons already alluded to—being bedfast, poor general condition, etc.—to the transglottic form of intratracheal injection with the use of the laryngeal mirror, Rosenthal's procedures may be employed, to wit:

(1) **Cricothyroid injection** by means of the special instrument devised by this observer, *viz.*, a syringe with a curved needle, to avoid injury to the posterior wall of the trachea, and which is very readily plunged through the cricothyroid space.

(2) **Tracheo-fistulization,** resorted to where the gravity of the disease is such as to demand frequent repetition—daily or twice daily—of the injections. To avoid traumatizing the region, Rosenthal prefers to introduce through or below the cricothyroid space an extremely fine permanent cannula—a miniature tracheotomy tube—which does not in the least interfere with respiration or phonation and which permits of the painless introduction of antiseptic fluids into the trachea and bronchi. A tracheal "drop" procedure may even be employed, absolutely like the drop method of proctoclysis.

II.—PROCEDURES RELATING TO THE LOWER RESPIRATORY TRACT.

(*In collaboration with* P. DESFOSSES. M.D.)

I.—PARACENTESIS THORACIS.

Paracentesis of the chest consists of making a puncture into the pleural cavity and withdrawing from it by means of an aspirating device all or part of an effusion which is contained in it.

Indications and Contraindications.—When the presence of an effusion is already known, there are two main considerations justifying paracentesis:

1. Size of the effusion.
2. Persistence of the effusion.

An effusion is considered one of large size (over 1500 c.c.)—by means other than fluoroscopy—when flatness ascends behind the scapula, Skoda's resonance tends to disappear in front of the clavicle, the breath-sounds assume the bronchial type and are heard in both phases of respiration, and the neighboring organs—heart and liver—are displaced.

Persistence of the effusion beyond the fifteenth or the twentieth day requires the performance of paracentesis. The latter is particularly indicated in serous pleurisy, the suppurative forms of pleurisy requiring pleurotomy instead, except in the case of pleurisy due solely to the pneumococcus, in which simple paracentesis may be followed by recovery, and in tuberculous pleurisy, in which paracentesis is the treatment of choice, operation being always contraindicated.

Puncture should be done earlier, especially in heart cases, if the effusion is on the left side, and in diaphragmatic, influenzal or typhoid pleurisy; likewise when there is pronounced, constant dyspnea, insomnia, restlessness and a tendency to syncope.

Apparatus.—Selection of the apparatus is of little importance; one may use without distinction the Potain aspirator or that of Dieulafoy, both of which are excellent.

The needle should be of small caliber, No. 2 or 3, and provided with a silver stylet to insure patency of its lumen. There should also be at hand some tincture of iodine, a basin or bowl in which to empty the contents of the bottle when it is filled, and some ethyl chloride.

Preliminary Preparations.—The area selected should be asepticized by cleansing with soap and water, rubbing with alcohol or ether, and application of iodine.

The trocars and rubber attachments of the receptacle should be boiled or otherwise sterilized. The operator should make certain that the apparatus is in working order, and if need be, should make preliminary tests *in vitro* by aspirating some sterile fluid. A vacuum should be produced in the glass bottle.

The patient is seated with the chest bent forward, the arms abducted, and the hands resting on the thighs or held by an assistant; if he is predisposed to syncope, however, it is better to have him lie down on his side at the edge of the bed. A folded sheet should be

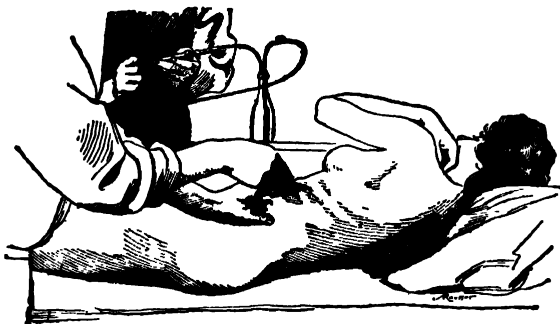


Fig. 178.—Paracentesis thoracis in lateral decubitus.

placed under the axilla on the sound side to afford good support to the chest and render the diseased side prominent. The arm of the affected side should be raised over the head.

In sensitive or timid patients, the site of puncture may be at least partly anesthetized with the ethyl chloride spray.

Technic.—The site of puncture varies according to the situation and extent of the effusion. It is selected either in the sixth or seventh costal interspace in the axillary region or in the seventh or eighth costal interspace along a horizontal line, passing through the inferior angle of the scapula, in front of the outer margin of the latissimus dorsi muscle.

It is a general rule, however, to make the puncture where one is sure to find fluid and at the most dependent point of the effusion.

Previous to paracentesis it is always prudent to make an exploratory puncture at the point selected. This having been done, a vacuum having been established in the apparatus, and the needle

having been connected with the rubber tube leading to the aspirator, the operator proceeds to carry out the paracentesis. He places his forefinger in the interspace selected, in such a manner that the upper border of the finger shall mark the lower border of the superjacent rib and the lower border of the finger, the upper border of the rib below.

At this juncture, with the needle held firmly in the right hand and its butt end well braced against the palm of the hand, the forefinger, extended along the needle and limiting its excursion to about 3 centimeters ($1\frac{1}{5}$ inches), pushes it through the tissues just in front of the nail of the left forefinger and causes it to penetrate the chest wall. A sense of loss of resistance indicates when the needle has entered to a sufficient depth. The stylet in the trocar or needle is then removed and the stopcock of the aspirator opened, when the fluid from the chest will spurt into the receptacle. The fluid should not be withdrawn too quickly and while spurting to the full extent. It is therefore advisable, as soon as the initial spurt has taken place, to half close the inflow stopcock in order to reduce the force of the aspiration somewhat.

When the aspirator is filled the turncock on the needle side is closed and the receptacle emptied. The vacuum is then re-established and the aspiration repeated; this maneuver is repeated several times, if necessary. When a liter of fluid has been obtained the aspiration is discontinued, as a rule; one has merely to withdraw the needle while pinching the skin between the left thumb and forefinger, the right hand exerting traction on the needle obliquely.

As soon as the needle has been taken out the tissues at the puncture hole are kneaded a little in order to destroy the continuity of the opening through the different tissue layers.

The wound remaining from the passage of the needle is a trifling one and the orifice need merely be painted with a little tincture of iodine.

The amount of fluid to be withdrawn should not, as a rule, exceed 1000 to 1200 c.c., especially in long-standing pleurisy or in cases in which interference with the compensatory pulmonary expansion is suspected.

Complicating Factors.—Puncture against a Rib.—When the chest wall is thick, the finger may not feel the bony prominences sufficiently and the needle, improperly directed, may abut against the rib above or below. In this event, the needle should be withdrawn slightly and directed higher up or lower down.

Dry Puncture.—Where the preliminary exploratory puncture has been negative, the cause is either that the needle has not been inserted

deeply enough, that it is occluded with false membrane, or that the lung has been punctured. The cannula should be withdrawn and re-introduced elsewhere in the vicinity.

Stopping of the Stream.—Sometimes the jet of fluid abruptly stops; this means that false membrane is obstructing the lumen of the needle. The remedy is simply to open the stopcock and insert the blunt obturator through the trocar, when the flow will be seen to re-appear.

Cough.—At times a paroxysmal, obstinate cough appears during the puncture. It is arrested by stopping the flow temporarily or permanently. The cause of the cough is often an unduly rapid removal of the fluid.

Accidents.—More serious accidents which may be observed are the following:

Breaking of the needle in the chest wall may bring on a circumscribed pleurisy.

Infection of the pleura or of the chest wall may be due to two causes: Faulty asepsis or passage of the needle through foci of infection.

Injury of the Lung or Liver.—This is avoided by restricting the depth of penetration of the needle to about 3 centimeters (1⅕ inches). Further, if the puncture of these organs is aseptic it is generally harmless, as shown by the innocuousness of exploratory punctures of the lung or liver. Albuminous expectoration, in all likelihood the result of edematous congestion of the lung, is avoided by taking care never to remove more than 1000 to 1200 c.c. of fluid at one sitting.

Pleural Reflexes: Cardiac or Respiratory Depression, Convulsions, Coma, Paralysis.—In these cases there has nearly always occurred puncture of the lung, with the lung in a state of induration. In cases with concomitant heart disease, the recumbent position should be preferred, and one should operate only with the finest needle compatible with the requirement of evacuating the fluid. In the presence of pneumonia the site of puncture should be selected with care and the needle inserted only just deeply enough to reach the fluid.

In the event of syncope, treatment by the usual measures should be given—ether, caffeine, camphor in oil, artificial respiration, and rhythmic traction on the tongue.

After-care.—Absolute rest of the patient, roborant measures and breathing exercises.

II.—PLEUROTOMY.

Pleurotomy consists in making an opening into the pleural cavity for the removal of a purulent exudate.

The fundamental principle is simple: Any pus collection in the pleura (like any pus collection elsewhere) should be opened freely at the most dependent point.

According to the case, this incision may or may not be preceded by rib resection.

Indications.—Simple pleurotomy should be carried out when exploratory puncture reveals a purulent exudate in a case of *recent pleurisy* in which neither the obtrusion of false membranes nor the formation of a wall of fibrous tissue will have to be apprehended.

Apparatus.—The following articles should be available:

A needle for local anesthesia.
A puncture needle.
Two glass syringes.
A scalpel.
Retractors (Farabeuf's).
A pair of long dressing forceps.
A pair of dissecting forceps.
Six hemostats.
A grooved director.
A Doyen needle.
Two large drainage tubes.
A solution of cocaine or stovaine (1 per cent.).
Tincture of iodine.
Alcohol.
Towels.
Rubber gloves.
Cotton compresses, bandages and safety-pins.
Basins, dishes, boiled water, and soap.
Catgut and horse-hair.

Preliminary Preparations.—If the operation is to take place at the patient's home, all arrangements required to insure asepsis should be made. An appropriate table should be prepared for the reception of the patient and covered with a folded sheet; two small tables covered with towels should be obtained for the instruments.

The region to be incised should be shaven if need be, carefully washed with soap and water, rinsed and painted with tincture of iodine.

Local or general anesthesia with ethyl chloride should be instituted.

Technic.—The most dependent point of the pus collection should be ascertained by exploratory punctures, repeated from above downward if necessary.

The incision is made at the point of puncture, parallel to the rib and along its upper border, in order to avoid the vessels. The margins of the wound are retracted, and the muscles on the rib itself, forming a plane of resistance, incised. If an artery is wounded, it is checked with a hemostat.

The upper border of the rib exposed having been located, the costal interspace is next incised with short strokes along the upper border of the bone.

The pleura is now punctured with the point of the scalpel and the incision enlarged, with the left forefinger as guide if necessary.

The patient should be so tilted as to secure better evacuation of the cavity.

Drainage should be established with tubes as large as possible, thick-walled and sufficiently rigid, and long enough to extend to the bottom of the pleural cul-de-sac. The drainage tubes are directed with the dressing forceps. When they are all the way in, a safety-pin previously passed through a flame is pushed through them to arrest their progress and keep them from falling into the pleural cavity.

A dry dressing is applied.

Accidents.—These are to be feared only by the operator, who may receive a jet of pus in the face at the moment of incision into the pleura. He should take care so to adjust the position of the patient and his own as to avoid this untoward happening.

After-care.—The patient is put back in his bed in the sitting position and, if necessary, given stimulation with an injection of camphor in oil.

The dressing should be changed twice a day as long as the suppuration continues abundant. The drainage tubes should be withdrawn beginning on the third day and replaced by other sterile tubes.

This is the customary after-treatment. If suppuration persists, irrigations under low pressure with boiled water, physiologic salt solution, dilute iodine solution or Dakin's solution may be tried.

The patient's pillow and bed should be protected with oilcloth covered by a folded sheet.

Tuffier's Technic (Carrel Method).—After evacuation of the pus, Carrel tubes are introduced into all recesses of the pleura and fastened to the skin with adhesive plaster strips. Dakin's solution is injected into each of the tubes every two hours. After five to thirty days disinfection of the pleura is obtained and surgical closure of wound is carried out.

III.—PLEUROTOMY WITH RIB RESECTION.

Rib resection has for its purpose to afford a larger opening into the pleural cavity and thus permit of its examination by the sense of sight and of cleansing of the wall with tampons.

Indications.—Rib resection should be combined with pleurotomy in traumatic pleurisy, long-standing pleurisy, and pleurisy with fistula formation.

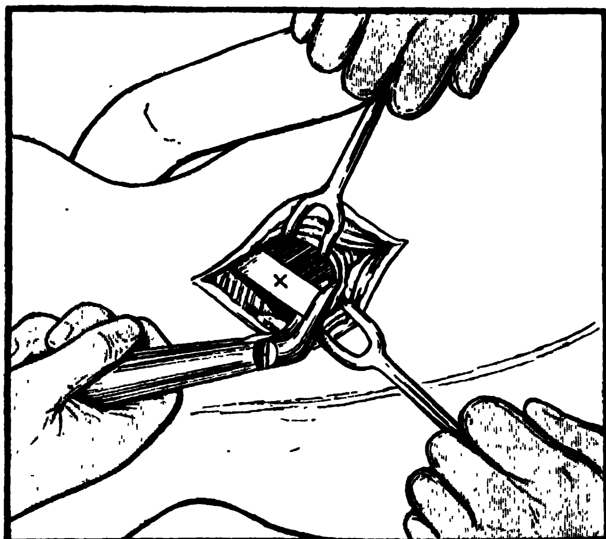


Fig. 179.—Operation for empyema. Second step: Section of the 10th rib (*Grover*).

Apparatus.—To the articles required for pleurotomy should be added:

Tuffier's retractor.
A costotome.
A raspatory.
Long forceps.
A projector of light.

Preliminary Preparations.—These are the same as for simple pleurotomy and should include observance of the strictest aseptic precautions.

General anesthesia may be employed; in general, however, local anesthesia is preferred.

Technic.—Exploratory puncture. Incision of the skin and muscles as for simple pleurotomy.

Incision of the costal periosteum along the middle of the rib. The periosteum is carefully detached with the raspatory on the outer aspect of the rib, next on its borders, where the intercostal muscles are to be liberated with great care, then on the posterior surface, where the periosteum is much less strongly adherent and is very easily detached.

One of the blades of a good pair of cutting forceps or the concave jaw of the costotome is then inserted behind the rib under the guidance of the index finger, and the rib resected first at one, then at the other end of the wound, in such manner as to obtain an opening at least three or four fingerbreadths long, without any stumps of bone projecting into it.

The deep costal periosteum is then cleansed, and the pleura punctured and incised as already described. The pleural cavity should be emptied as well as possible by suitable posture of the patient; it should then be examined visually with the assistance of a light projector and stripped of its false membranes by means of a tampon mounted on long forceps. If necessary, the cavity should be washed out with warm boiled water, physiologic salt solution or hydrogen peroxide solution.

The drainage and after-care are similar to those already described under simple pleurotomy.

The customary mode of drainage consists in the use of two closely apposed stiff rubber tubes so disposed as to extend deeply into the costo-diaphragmatic cul-de-sac.

IV.—ARTIFICIAL PNEUMOTHORAX.

The production of an artificial or therapeutic pneumothorax consists in the injection of air or some other gas into the pleural cavity. When *indicated, feasible,* and *properly carried out,* artificial pneumothorax is the best method now known of treating localized pulmonary tuberculosis.

Object of the Procedure.—It has for its purpose to immobilize the affected lung and thus place the tuberculous lesions at rest, by making use of the intrinsic property of lung tissue, elasticity.

Clinical Indications.—A. **In Tuberculosis.**—Only in cases of tuberculosis with *unilateral* and *actively developing* pulmonary lesions is the procedure indicated, and such cases are relatively few.

1. *The lesions must be unilateral.*—This is determined by auscultation, the findings of which are to be supplemented and confirmed by a fluoroscopic examination.

2. *The lesions must be actively developing.*—This feature of the lesions can be brought out by a study of the functional signs (cough, dyspnea, expectoration) and of the general symptoms (fever, sweats, loss of weight, and anemia), together with bacteriologic examination of the sputum.

Pneumothorax is indicated as early as possible, without waiting until the situation is desperate:

(*a*) In chronic tuberculosis, in the *caseous* forms, especially when there is a lobar localization, whether or not laryngitis is present, and in the *hemorrhagic* forms, in which, by virtue of its immediate and decisive effects, it constitutes the capital treatment of grave hemoptysis.

(*b*) In acute tuberculosis, in the *pneumonic* or *bronchopneumonic* forms (Poix).

B. **In Conditions Other Than Tuberculosis.**—1. Abscess of the lung or interlobular abscess; suppurating hydatid cysts.

2. Bronchiectasis at the base of the lung; pulmonary gangrene, and unilateral fetid bronchitis.

Contraindications.—Pneumothorax should not be instituted:

1. In patients with the *fibrous, granulomatous,* or *septicemic* forms of tuberculosis.

2. In patients with *cardiac insufficiency* from whatever cause, with tendency to dyspnea or cyanosis, a small and rapid pulse, and low blood-pressure.

3. In *cachectic* tuberculous patients who yield a negative skin reaction attesting to inadequacy of all the mechanisms of systemic defence.

Precautions to be Taken.—Pneumothorax is obtainable only if the two layers of the pleura are sufficiently free to permit of their being separated, *i.e.,* if there is absence of *extensive pleural adhesion.* The diagnosis of such adhesion is based on retraction of the intercostal spaces during inspiration, asymmetry of the chest, and, in particular, on the fluoroscopic examination, which will show obliteration of the costo-diaphragmatic sinus, diminished amplitude of the movements, and sometimes immobility of the diaphragm on the affected side. None of these signs is of absolute value; one or more attempts should always be made, after having warned the patient of possible failure.

Before instituting a pneumothorax, the physician should make sure that the *social* and *mental conditions* of the patient are such as will enable him to undergo reinflations at least two or three times a month for a period of at least two years.

Technic of Artificial Pneumothorax.—Procedures Employed.—1. That of puncture, advocated by Forlanini for over two decades.

2. That of Brauer, who prefers an incision with the scalpel through the superficial layers down to the pleura and the introduction of a blunt cannula.

Only the first of these procedures will be described here; the second should be reserved for special cases in which punctures may have failed.

Apparatus.—The various forms of apparatus consist of three parts:

1. A system of two interconnected bottles. The one contains the gas to be injected; the other the fluid, displacement of which permits of controlling the outflow of gas.
2. A water manometer.
3. A puncture instrument connected with the preceding parts of the apparatus.

The various puncture instruments devised by Forlanini, Schmidt, Saugman, P. Courmont and von Muralt will not be described here. Description of the Küss instrument and of the more recent device of Leuret and Delmas seems sufficient.

A. Küss's Apparatus.—The bottle, F, containing the fluid is stationary. It is graduated up to 600 cubic centimeters. The bottle, F,' is movable, being displaced vertically by a rack-and-pinion arrangement. A movable scale, R, is placed behind F and permits of reading off the difference of elevation between the two bottles. The quantity of fluid contained in the bottles is such that when F' is at the bottom of its course, the horizontal plane passes through the zero on the scale, while when F' is at the top of its course, the bottle, F, is filled without overflowing. All serviceable pressures, positive or negative, can be obtained in F, which makes it possible, as stated by Küss, "always to allow the patient to draw in the nitrogen himself with his respiratory movements."

The respiratory movements of the patient are reproduced in the bottle, F, in the form of ascensions of the fluid during inspiration alternating with periods of respiratory pause. The physician is thus certain that the needle is actually in the pleural cavity.

The manometer formed by the two bottles, F and F', makes it possible during the injection to measure the intrapleural pressure by moving the bottle, F', to an elevation at which a flow of nitrogen will occur.

The apparatus includes also a manometer, M, and a rubber tube for connecting the nitrogen tank with the bottle, F.

The bottles and manometer contain a 1 : 1000 solution of mercury bichloride, colored red with a little acid fuchsin. The inlet and outlet tubes of the apparatus are guarded with cotton filters, F_1 and F_2.

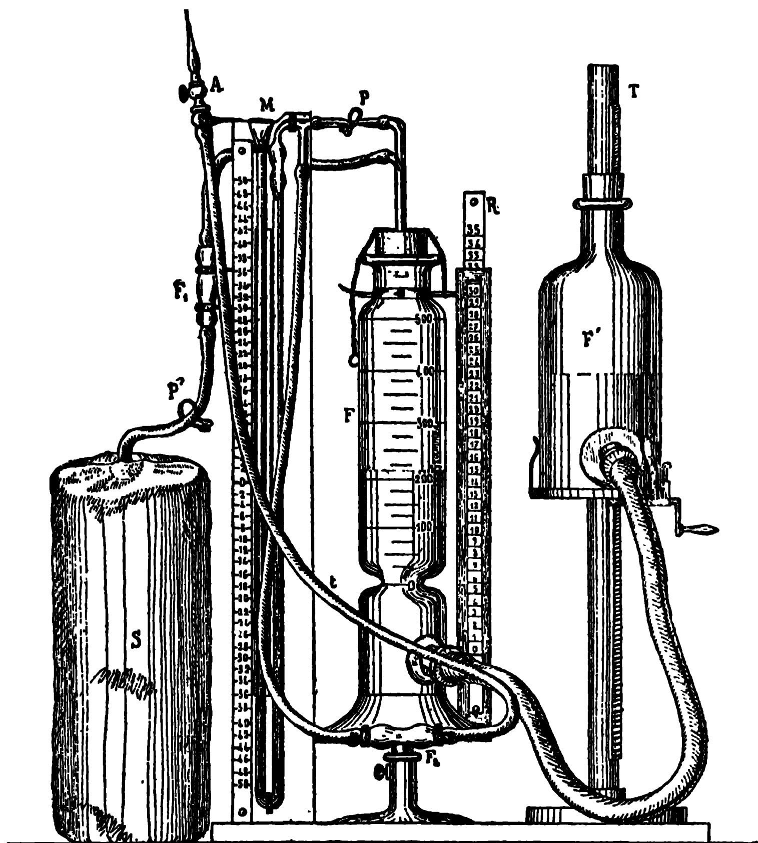


Fig. 180.—Küss's apparatus for artificial pneumothorax.

Cannula for the First Injection.—The cannula admits a sharp trocar 1 millimeter (1/25 inch) in diameter. A blunt obturator is substituted for it. Along the latter is a flattening which forms with the cannula a narrow channel connecting through a lateral orifice with the nitrogen tube. By giving the obturator half a turn, communication of this channel with the orifice in the cannula may be established

or cut off at will; the nitrogen tube is connected through a lateral glass inlet tube.

Gas to be Used.—The gas most commonly used is nitrogen. When nitrogen is unavailable, oxygen is sometimes substituted for it. The best gas to use, however, is air, suitably filtered through sterile cotton.

Billon, of Marseilles, advocates the introduction of antiseptic vapors. He has the nitrogen bubble through pure gomenol. Some observers have injected fluids, such as olive oil or water, in cases with adhesions.

Preparation of the Apparatus.—Nitrogen is introduced into the bottle, F. The operator makes certain that the colored fluid is at the zero level in the manometer, M. The filter, F_2, is replaced by a similar sterilized filter and the rubber tube, previously sterilized and very carefully allowed to drip, connected with it. The little glass side-tube is connected with the free end of the rubber tube and tied in tightly, and on it is screwed the cannula, previously sterilized, along with the obturator and the trocar, by boiling in borax solution. The trocar is then laid in the pronged metallic support, A. Care is taken to see that the whole device is thoroughly airtight and that the necessary flow will occur through the filter, F_2, and the inner channel of the cannula with the blunt obturator in place.

B. The Leuret and Delmas Apparatus.—The best apparatus available at the present time appears to be the Leuret and Delmas insufflator.

This apparatus is composed of two parts:

1. The gasometric chambers.
2. The manometers.

1. Gasometric Chambers.—Two Woulfe bottles, numbered 1 and 2, are placed one above the other. They have three tubular outlets and a capacity of 500 c.c.

The lower vessel is graduated from 0 to 500 c.c. Two of the three tubular outlets of vessel No. 1 are connected with the corresponding outlets of vessel No. 2 by the tubes R_1 and R_2, furnished with taps. The remaining outlet of each vessel is connected with a distributor, D, constituting a five-way tap bearing the following notations: In = insufflation; G = air or gas supply; A = stop; As = aspiration. The lower opening of the distributor is connected with the manometers, the filter, F, and the puncture needle, A. The two upper openings, E and S, may be connected with a rubber bulb, F, provided with a filter, F′.

2. Manometers.—Between the needle and the distributor are placed two U-shaped water manometers. One is of the ordinary oscillating type. The other, M, is a compensating manometer of the Marey type. It differs from the first by being provided with an adjustable constriction, V, in the course of the column of liquid. This constriction deadens the oscillations which the manometer would otherwise be apt to show on account of the respiratory variations of the intrapleural pressure. It affords always a definite pressure

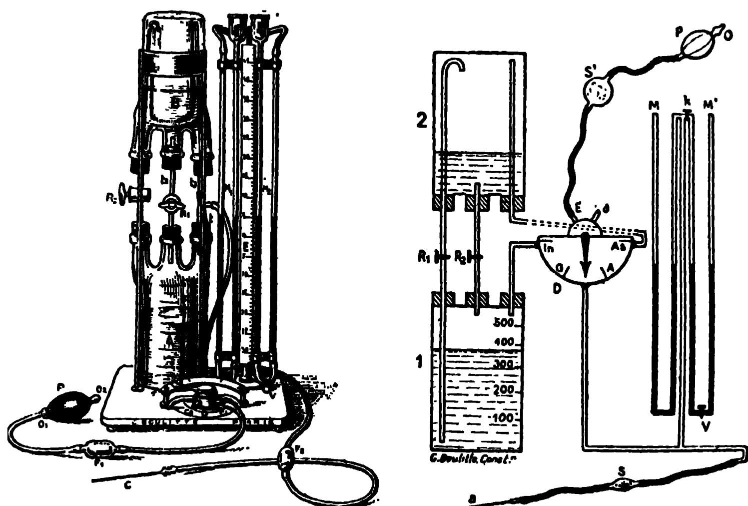


Fig. 181.—The Leuret and Delmas apparatus.

notation, which is the "mean dynamic pressure" or "effective intrapleural pressure," and this in spite of the respiratory oscillations.

Manipulation of the Apparatus.—Five hundred c.c. of a solution of cyanide of mercury are placed, once for all, in the vessel No. 1.

1. *Filling the Apparatus with Air or Gas.*—The rubber bulb system, P, is adapted to the inlet, E, of the distributor. The pointer on the distributor is turned to the filling mark. The tap R_2 is closed, while R_1 is left open. The bulb being now compressed, the air expelled by it, filtered at F′, fills bottle No. 1 and drives out the liquid in bottle No. 2 through the tube R_1. The apparatus is now charged with air. To charge it with nitrogen or oxygen, the olive, O, of the bulb, P, is simply connected with containers filled with these gases and the manipulation carried out as above stated.

2. *Insufflation.*—The pointer of the distributor is turned to the mark for insufflation ("In"). The tap R_2 is opened as far as may be necessary. The liquid in vessel No. 2, entering into vessel No. 1, expels the gas from the latter. To stop the insufflation, the indicator is turned to the stop mark ("A").

3. *Aspiration.*—To aspirate the gas contained in a pleural cavity, the maneuver is the same as for insufflation, but with the distributor pointer turned over the aspiration mark ("As"). The gas in the pleura will then pass into bottle No. 2 to replace the fluid flowing out of it.

4. *High Pressures.*—To secure insufflation at very high pressures, the same steps are taken as for an ordinary insufflation, except that the rubber bulb, P, is adapted to the inlet S of the distributor. The fluid is driven from bottle No. 2 to bottle No. 1 by compressing the bulb, P.

5. *Reading off the Pressures.*—The variable pressures are read off at the manometer, M. The mean pressure is read off at the manometer M′; a small cock, K, permits of cutting off this manometer during the passage of the gas, in order to avoid its showing a fictitious reading. A reading is made, say, each time that 100 c.c. of gas have been introduced or withdrawn. The figures corresponding to the mean pressure can be charted on quadril paper. A curve of the insufflation is thus obtained.

Preparation of the Patient.—The patient should be encouraged to remain quiet. He should receive a small amount of morphine by the mouth, or, if very restless, a hypodermic injection of morphine.

He should be placed in recumbency on the sound side, and a cushion such as will impart a curve to the chest slipped under the latter. The arm should be raised. Skin disinfection is proceeded with and a 1 per cent. solution of stovaine [or 1.5 per cent. solution of procaine.—Tr.] is injected at the site of the intended puncture.

The point of election is, as a rule, in the axillary region, in the fourth or sixth costal interspace, one or two fingerbreadths from the anterior border of the latissimus dorsi muscle. If puncture at this point fails, one may try another below the angle of the scapula.

The skin surface is anesthetized with ethyl chloride. The trocar, held by the right hand, is directed at right angles to the chest wall at the upper border of the subjacent rib. The trocar, having passed around this upper border of the rib, is introduced through the adjacent portion of the costal interspace, pierces the external intercostal muscle, and is brought to a stop at the internal intercostal muscle. At this juncture the trocar is taken out and replaced by the blunt obturator. The aponeurosis and parietal pleura are then perforated, and the cannula should be free in the pleural cavity. If such is the

case, upon rotating the obturator through half a turn in the cannula slight oscillations will be seen to appear in the bottle. The obturator is then removed and extensive oscillations corresponding with the phases of respiration are observed. There remains but to inject the nitrogen.

Complicating Factors During the Procedure.—Sometimes the pleura, being slightly thickened, will not give way at once to the obturator. The latter should not be pushed on, as it would detach the parietal pleura. Instead, the trocar is substituted for the obturator, thus enabling the physician to puncture the tense membrane.

If no oscillations indicating entrance into the pleural cavity occur, there are three possibilities:

1. The cannula is occluded; in this case the manometer shows no oscillation whatever.

2. The cannula has entered the lung; the manometer shows slight oscillations extending alternately above and below the zero mark.

3. The cannula has been driven into adhesions; a few slight oscillations without depression are observed. An attempt may be made to rupture the adhesions by injecting nitrogen under high pressure.

Accidents.—These are very exceptional:

1. Injury to the intercostal vessels or nerves, or to a rib.
2. Wounding of the lung.
3. Subcutaneous and mediastinal emphysema.
4. Serious accidents, the pathogenesis of which is unknown.

Later Injections.—The first reinjection should be made with a blunt cannula, like the initial injection. Subsequently, a needle should be used. The intrapleural pressure is progressively increased, the course of the pneumothorax being kept under observation both by auscultation and by fluoroscopy. When complete collapse of the lung has been obtained, one has merely to keep up the required pressure. The earlier reinjections are made weekly; later, longer intervals are allowed.

If displacement of the mediastinum is noted on fluoroscopic examination the pressure is increased only very slowly.

Complications Developing in the Presence of Pneumothorax.—The most frequent complication during pneumothorax treatment is the appearance of fluid in the pleura.

These pleurisies are either silent pleurisies, or febrile and generally sero-fibrinous pleurisies, or pleurisies primarily or secondarily suppurative.

Immediate Effects.—These vary greatly. In many patients they are favorable; the temperature subsides, expectoration becomes less, and

the tubercle bacilli gradually disappear from the sputum. This is the most important immediate result from the standpoint of family and social prophylaxis. The appetite returns and the general condition improves.

Remote Results.—If the case has been judiciously selected, at the end of at least two years of maintenance of the pneumothorax, a more or less complete clinical cure is obtained in *more than half of the cases;* it is characterized histologically by a permanent fibrotic change in the lesions. In the other half of the cases, the course is unfavorable on account of the development of lesions on the opposite side, perforation of the lung, septic pleurisy, or, more exceptionally, intestinal or meningeal complications (G. Poix).

VII

THERAPEUTIC PROCEDURES RELATING TO THE URINARY TRACT.

BY DR. SAINT-CÈNE.

IRRIGATION OF THE BLADDER.

Irrigation of the bladder may be carried out either with or without a catheter.

(*a*) *Irrigation without a catheter* is indicated in cases of urethrovesical infection when the bladder is able to empty itself well without assistance and the infection renders the introduction of instruments undesirable (gonococcal urethritis).

The fluid should not be thrown directly into the bladder. Cleansing of the glans and of the anterior urethra should be carried out first. If there is difficulty in getting the fluid to pass all the way into the bladder, a preliminary injection of cocaine into the canal may be made.

For the details of the procedure, the reader is referred to the section on *Gonorrhea.*

(*b*) *Irrigation through a catheter* is indicated in bladder infections in general, in pyuria of reno-ureteral or of vesico-prostatic origin, and in some cases of chronic cystitis.

The introduction of the catheter should be effected in accordance with the usual rules appertaining to this procedure (see Martinet: *"Clinical Diagnosis"*).

The irrigation itself is subject to variations in different cases. If *acute cystitis* is present, one should beware of the procedure. It is often more harmful than useful and instillations into the bladder are to be preferred to it.

If, however, irrigation is necessary, either to evacuate pus-laden urine, for examination of the interior of the bladder, or for any other reason, the procedure should be as follows:

In the first place, it must be taken for granted that the operator is certain of his aseptic precautions (asepsis of catheterization, of the instruments, of the fluid to be injected and of the operator himself).

The bladder syringe having been filled, the fluid is introduced *slowly and gradually*. If several syringefuls are to be administered, one should

not wait until the bladder has emptied itself completely before filling it again (to avoid painful contraction of the organ, which would soon become intolerant).

The quantity of fluid to be injected at one time depends on the sensitiveness of the bladder. Especial care should be taken not to inject forcibly and distend the bladder unnecessarily.

In chronically infected and long-standing prostatic cases, on the other hand, it is sometimes advantageous to distend the bladder to a moderate degree to secure better irrigation.

Under such circumstances it is well to continue the irrigation until the fluid comes back clear; if necessary, the point of outflow should be changed and the catheter—especially if it is an elbowed catheter—placed in succession in various parts of the bladder so as to insure complete evacuation of the organ.

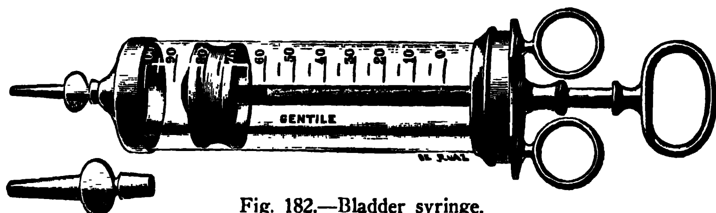


Fig. 182.—Bladder syringe.

Pasteau has advocated bladder distention in some cases of pyelonephritis for the purpose of securing patency of the orifices of the ureters and facilitating the evacuation of abnormal products from the ureter and the renal pelvis.

The fluid to be injected varies in different cases.

The best antiseptic agent for bladder infections, especially in prostatic patients, is still *silver nitrate* in 1:4000 to 1:1000 solutions. It may, on occasion, be replaced by protargol, 1:1000, mercury oxycyanide, 1:4000 to 1:1000, or boric acid.

If mercury oxycyanide is used, inquiry should be made beforehand as to whether the patient is taking an iodide. If so, the oxycyanide should not be used, as it forms the strongly caustic mercuric iodide with the iodide eliminated in the urine, and the patient would strongly resent the painful cystitis induced by this procedure.

Irrigation Followed by Aspiration.—At times it may be necessary to supplement the irrigation by aspiration of the bladder.

This is the case where the bladder is filled with large clots, mucous discharges, or (occasionally) foreign bodies. Aspiration is definitely indicated, in particular, in severe bladder hemorrhage, *e.g.*, in tumors of the

bladder. Not only is it the only feasible procedure for emptying the organ and allaying the pain—sometimes very intense—due to the clots, but it is also the best means of arresting the hemorrhage.

Aspiration under these conditions is possessed of actual hemostatic value.

The procedure should be as follows:

The catheter should be of the elbowed type and of as large a caliber as possible, with large openings; sometimes the evacuating tube used in litholapaxy is employed. The catheter having been introduced, the bladder syringe is filled with the sterile fluid; then, without completely emptying the bladder, and while holding the penis and catheter securely with the left hand, with the syringe fitted into the proximal end of the catheter, the operator aspirates the fluid from the bladder by drawing out the plunger of the syringe. Soon the clots begin to come through, and gradually, he succeeds in emptying the bladder and relieving the pain.

It is sometimes of advantage to have an assistant to draw out the plunger while the operator is holding the catheter and the syringe.

In hard cases, complete success in the aspiration will be obtained only by the use of the evacuating tube employed in litholapaxy.

INSTILLATIONS.

Instillations have for their purpose to place directly in the posterior urethra or at the neck of the bladder a small quantity of a concentrated medicinal solution, *e.g.*, silver nitrate, 0.5 to 2 per cent.; argyrol, 5 to 20 per cent.; protargol, 1 to 10 per cent., etc.

The instrument used for the instillations is frequently Guyon's syringe, but this may be very conveniently and inexpensively replaced by the small *plungerless instillation syringe of Bonneau,* which possesses the advantage of being easily sterilized. The instillation syringes with silver plungers are also very serviceable and are much superior to the former syringes with leather plungers.

For introducing remedies into the posterior urethra, the instillating catheters or instillators of Guyon [or Keyes] are used.

Before carrying out an instillation, care should be taken to have the patient urinate.

The instillator having been sterilized and suitably lubricated, it is introduced in the meatus, held open by the fingers of the left hand.

It is well not to pick up the instillator directly with the hand. It is just as easy to hold it with sterile hemostatic forceps or, if desired, special forceps.

The instillator is introduced until it reaches the bladder, then drawn back 1 or 2 centimeters (2/5 to 4/5 inch) so that the fluid will issue in the prostatic urethra. If necessary, one may continue to discharge the fluid along the entire urethra by keeping up the injection of the syringe contents during the whole period of withdrawal.

The precaution should be taken of never injecting the fluid too rapidly or with undue pressure. This will avoid penetration of the fluid into the spermatic channels.

As a rule, the medicinal fluid is placed in the urethra (urethral instillation). In cystitis (tuberculous or gonorrheal), however, it is discharged into the bladder (bladder instillation).

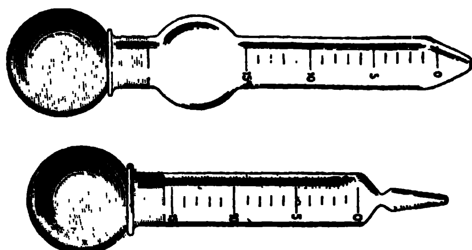


Fig. 183.—Bonneau's plungerless instillation syringes.

When it is desired to introduce in the bladder an amount of fluid larger than the normal capacity of the instillator, an ordinary catheter, such as a small elbowed catheter in men or a cylindrical round-tipped catheter in women, may be employed in connection with the larger sized (20-c.c.) Bonneau plungerless instillation syringe.

This plan is particularly to be commended for oily injections, which are disastrous with the ordinary syringes.

ASEPSIS AND ANTISEPSIS OF THE URINARY TRACT.

It is hardly necessary to emphasize the importance of asepsis in procedures relating to the urinary tract. The physician should never lose sight of the fearsome consequences of septic catheterization.

Extra-urethral Precautions.—Disinfection of the hands; cleansing of the glans and the meatus; the use of a small sterile towel should be universally adopted and would be of value in many cases.

Whenever possible the catheter should be taken hold of with forceps; it should be inserted directly into the well opened meatus, contact with the outer surface of the glans being avoided.

Urethral Precautions.—Only a sterile catheter, lubricated with sterile products, should be introduced. In emergencies and whenever catheterization is carried out with catheters that have not been used for some time and have been kept sterile in a more or less doubtful fashion, boiling is the simplest, safest and quickest plan. It is the procedure of choice for rubber catheters. Elbowed catheters made of good quality silk will stand being boiled several times very well.

For the practitioner's purposes, I prefer this procedure to the use of formalin tubes.

These tubes nevertheless afford a means of keeping catheters with a minimum of deterioration.

The catheter should be washed with soap and water and dried each time it is used. Injecting alcohol through the catheter with a syringe insures more complete dryness. After this the catheter may be placed carefully in a tube containing formalin tablets.

For the specialist, the sterilizers making use of formaldehyde gas liberated by heat (*e.g.*, Marion's constant temperature electric sterilizer) constitute the most effective and convenient method.

Once sterilized, the catheters may be kept in a special metallic case in which formaldehyde is slowly set free.

In irrigations of the urethra and bladder or of the bladder alone, care should be taken never to use any but absolutely sterile fluids (even in the case of antiseptic solutions).

In general, the practitioner should be very mistrustful of the antiseptics and use them only in *small, non-irritating amounts.*

LUBRICANTS.

The best lubricant for catheters is sterile oil.

Liquid petrolatum, a non-fermentable mineral oil, is superior to the oils of vegetable origin. It is well to keep the oils on hand only in small amounts.

Carbolated oils irritate the urethra and give a false sense of security. Sterile vaselin, easier to obtain on short notice than sterile oil, is a good substance to use in emergencies.

In sensitive patients, I often employ a useful means of lubrication which greatly facilitates the passage of elbowed catheters: I first inject in the urethra, using Bonneau's plungerless syringe with a nozzle of the Janet type, a few cubic centimeters of sterile oil.

The latter is held in the canal by pressure with the fingers and the elbowed catheter can then be introduced with great ease in a veritable bath of oil.

VARIOUS CATHETERS.

The simplest catheter is the Nélaton *soft rubber catheter.*

Its use is indicated in cases of acute retention of urine in patients

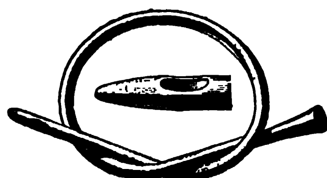


Fig. 184.—Nélaton soft-rubber catheter.

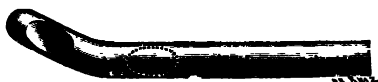


Fig. 185.—Elbowed catheter.

who give no history of a previous disturbance of the urinary tract, and in whom simple and easy catheterization is to be expected.

A No. 17 or 18 catheter with a funnel-shaped inlet should be selected.

Elbowed soft rubber catheters are also made, and are useful in some prostatic cases.



Fig. 186.—Double elbowed catheter.

The rubber catheter is also indicated for *catheterization over an obturator.*

It is advantageous in that it can be readily sterilized by boiling. It is advisable always to test the condition of the rubber by slightly stretching the catheter. As time elapses, such a catheter becomes stiff and brittle, so that it might break during catheterization and a piece of it remain in the bladder.

The *elbowed catheter of woven silk* should be the choice of the practitioner. The tip of its upturned end follows the upper wall of the canal and opens the way for the heel, which rests against the lower wall, on which the obstructions to the canal are located.

The ***double elbowed catheter*** facilitates catheterization in certain cases.

The *catheter with a large prostatic curve,* made of silk or rubber, presents the same advantages as does the ordinary soft catheter with the metallic curved obturator slipped through it.

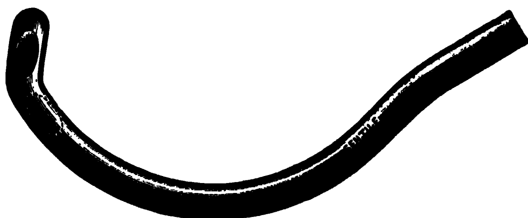


Fig. 187.—Catheter with prostatic curve.

The *cylindroconical (olivary) catheter* has few indications. Its use is attended with a risk of wounding the urethral tissue and making false passages. The specialist knows just when he should use it; the general practitioner should discard it.



Fig. 188.—Cylindroconical catheter.

The *cylindrical round-tipped catheter* is convenient for use in women, and is very serviceable for bladder instillations.

The *Pezzer self-retaining catheter* is useful as an indwelling or retained catheter.



Fig. 189.—Pezzer self-retaining catheter.

The *Lebreton catheter* has the same indications, but often yields better drainage than the Pezzer catheter.

CATHETERIZATION.

In this section the different forms of catheterization of the *urethra* and of the *bladder* will be considered together.

Viewed in this manner, catheterization has for its purpose either an examination of the urethra and the bladder (*exploratory catheterization*);

the evacuation of the urine in the bladder (*catheterization for evacuation*), or the dilatation of the canal (*catheterization for purposes of dilatation*).

I. EXPLORATORY CATHETERIZATION.—(a) **Urethra.**—Examination of the urethral canal is carried out with olivary bougies, Nos. 6 to 26 French. As Guyon has expressed it, exploratory catheterization with the bougie practically amounts merely to a *prolonged tactile contact, i.e.,* the instrument should be introduced and pushed through the urethra gently, in such a way as to *collect systematically* all sensory impressions which it is capable of affording. Both hands should be used in this procedure and come into play at the same time. With the left hand the penis is gently stretched in a vertical position; then, with the right hand, the olivary tip of the bougie is inserted into the canal and the bougie pushed in gently and gradually.

The bougie travels successively through the anterior urethra, the posterior urethra and the neck of the bladder.

Under normal conditions the physician is given notice of the entrance of the bougie into the prostatic region by the more pronounced and characteristic sensitiveness experienced by the patient; the entrance of the bougie into the bladder, in turn, yields a characteristic sensation of release.

As the instrument passes through the urethra, the operator is able to take note of the resistance offered by the walls of the canal, its softness, and the presence or absence of indurations or strictures; sometimes he is thus enabled to detect the presence of a stone in the urethra or the prostate.

Very often the progress of the bougie is arrested at the bulb by a *spasm of the urethra.*

The neophyte is apt to conclude that there is a stricture, or even an impassable stricture, although not the least trace of one exists.

To differentiate urethral spasm from an actual stricture, the operator must:

1. Wait, meanwhile making gentle pressure; very often, this proves sufficient to overcome the spasm.

2. Generally it is sufficient to replace the bougie by a rigid instrument (elbowed), which will pass easily where the soft bougie has failed. If necessary, a metallic obturator could be used.

3. Lastly, recourse may be had to cocaine or procaine in 1 per cent. solution, introduced to the seat of the spasm by means of an instillator; another, simpler plan is to inject the local anesthetic through the whole canal with a Bonneau syringe.

Systematic exploration of the canal supplies information to the observer regarding the existence, number, degree and resiliency of the stricture or strictures.

After having begun the examination with a bougie of intermediate caliber, he should change to a bougie of higher or lower number according to the case.

He may thus be led to resort to the filiform bougies.

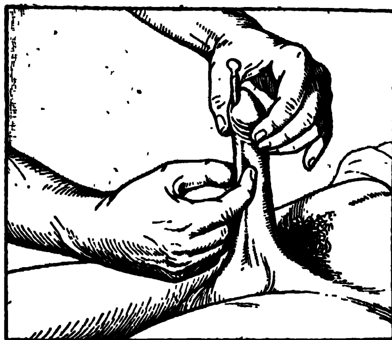


Fig. 190.—Palpation for Littré's glands.

When the object is to ascertain the condition of the walls of the urethra, particularly for the diagnosis and treatment of chronic inflammations of Littré's glands, it is convenient to explore the canal with a straight or even a curved catheter, against which palpation of the urethral walls is rendered easy.



Fig. 191.—Metallic sound for examination of the bladder.

(b) **Bladder.**—Exploratory catheterization of the bladder may be carried out with Guyon's metallic elbowed sound.

This instrument is intended for examination of the bladder cavity by the sense of touch, and permits of the detection of stones, of foreign bodies, of projections into the bladder (trabeculæ), and, *en passant,* of estimating the size of a hypertrophied prostate.

These sounds are available in several numbers: No. 1 for children; No. 2 for adults, and Nos. 3 and 4 for prostatic cases.

The instrument is introduced, in general, in conformity with the procedure applying in the insertion of metallic instruments with short curves (cystoscope, lithotrite, washing-tube in litholapaxy).

Before introducing the sound, it is advisable to place a certain amount of fluid in the bladder—100 to 150 c.c., or less in the case of a sensitive bladder.

The patient should be placed flat on a table or bed, with the pelvis raised rather high with a pillow.

The physician, standing on the patient's right, takes hold of the penis with his left hand and directs it toward himself. The instru-

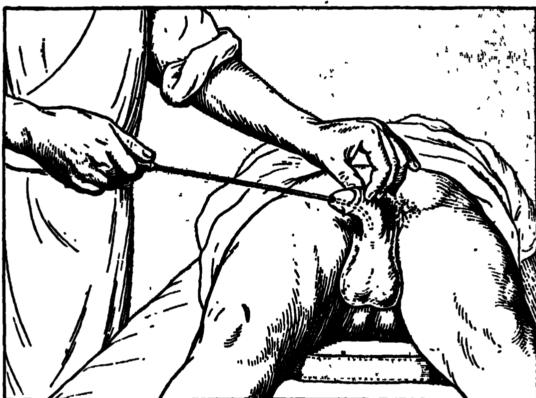


Fig. 192.—Introduction of the bladder sound. First stage.

ment, previously lubricated, is then introduced with the concavity of the elbow directed downward and the shaft of the sound perpendicular to the patient's right thigh. The sound now travels gradually through the canal, the handle of the instrument being meanwhile slightly raised.

The sound thus reaches the pocket of the bulb, its handle being increasingly elevated until it reaches the vertical position. The instrument seems to pass in of its own accord; it rotates spontaneously in the urethra, the elbow assuming an upward direction, as is indicated by the small projection on the handle, which should come to be directed downward.

Throughout this maneuver the operator's left hand has been holding the urethra, stretching it by holding it fixed against the instrument.

When penetration of the sound into the pocket of the bulb has been secured, which is easily recognized by the gripping sensation experienced, the operator lets go of the penis and with the left hand thus freed depresses the suprapubic tissues by pushing them downward; the right hand then has merely to let itself be guided by the instrument, which it holds lightly without exerting any force, and entrance of the sound into the bladder is noticed at once by reason of the complete sense of freedom experienced when this occurs.

In case the passage of the sound should meet with some delay,

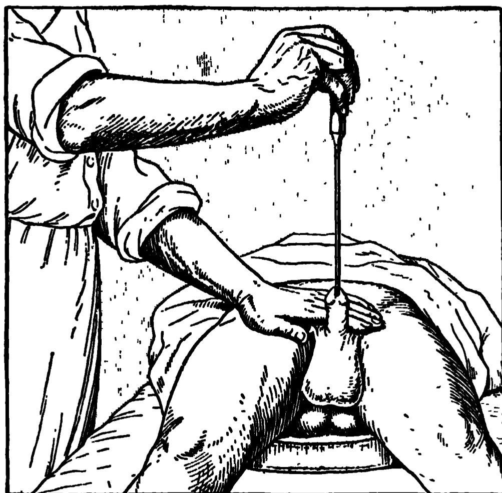


Fig. 193.—Introduction of the bladder sound. Second stage.

the instrument might be guided with the hand pressed against the perineum or even by a finger in the rectum, its penetration being thereby insured.

The more extensive use of the cystoscope has greatly reduced the indications for exploration of the bladder with metallic sounds.

II. CATHETERIZATION FOR EVACUATION.—This has for its purpose to remedy acute or chronic retention of urine.

Acute retention in a young man, occurring in the course of an acute inflammation of the urethral canal, including simple gonorrhea or gonorrhea complicated with prostatic abscess is, as a rule, readily dealt with by means of a soft rubber catheter.

Acute retention, however, generally occurs in elderly men who have been troubled with difficulty of urination for a period of time

and harbor very tight strictures of the urethra that have abruptly occluded the canal. In such a case, no catheter will go through, and recourse must be had to catheterization with the filiform bougie.

There are various kinds of filiforms (Fig. 194)—straight, twisted, and bayonet-tipped.

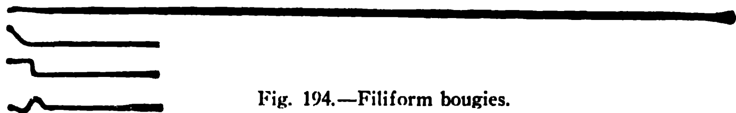


Fig. 194.—Filiform bougies.

Often, with a little groping, and especially, plenty of patience and gentleness, the filiform will pass through without any great difficulty; but sometimes, in the presence of extensive, very tight strictures, passage of the bougie proves extremely difficult, and calls, above all, for patience.

The best procedure to resort to under these circumstances is *bundle catheterization.*

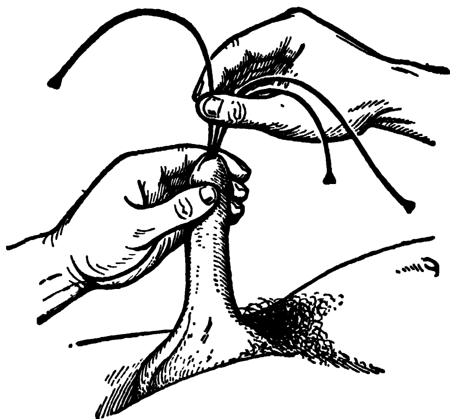


Fig. 195.—Bundle catheterization.

This consists in introducing first a single filiform, which is inserted as far as it will go in the stricture; this filiform having failed to go entirely through, a second, and if necessary a third, filiform, and even a fourth, are introduced in succession along the first filiform, left *in situ,* and one will rarely fail, with a little patience, and if need be, beginning all over again one or more times, to pass one of the filiforms through the stricture.

When the bougie is in place in the bladder, one has merely to leave it in for twelve to twenty-four hours, and the patient will be able to urinate along it.

Not rarely on the next day it will be found that a bougie of fairly large caliber, No. 8 or 9, can be passed without difficulty, and on the succeeding days, dilatation can be progressively proceeded with.

In old men, sudden, acute and very painful retention of urine is generally due to prostatic hypertrophy. The prostatic disturbance, indeed, often becomes first manifest in this way, in the absence of any marked preceding symptoms. There is, however, another form of retention in prostatics which is commoner still, *viz.*, a hidden form of retention or *chronic retention,* more or less pronounced, *with or without distention of the bladder:* The patient apparently urinates, but as a matter of fact he is urinating merely *by overflow,* passing only the excess of urine in

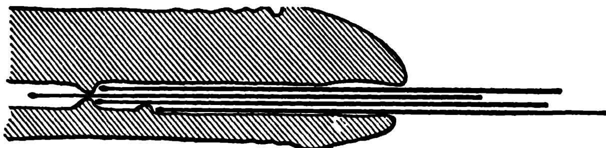


Fig. 196.—Bundle catheterization (*Marion*).

the bladder. The distended bladder forms a mass, which may be a source of diagnostic error.

It is important for every physician to be thoroughly familiar with this form of retention, and especially, to be impressed with the gravity of catheterization in such cases. These patients are in imminent risk of becoming infected, and are merely waiting for the entrance of the septic micro-organism which will be to them the starting-point of fatal complications: *More than ever must the physician be careful as to rigid asepsis.*

In the *uninfected prostatic patient with distended bladder* who has never been catheterized, suffering from retention, Marion warns against the danger of an initial catheterization and advocates *cystostomy* from the start. By virtue of the free drainage thus insured, infection of the urinary tract, so pregnant with risk for these patients, is avoided.

In a large proportion of cases, catheterization will be very easily effected with an ordinary soft rubber catheter.

Sometimes, however, when the factor of congestion is added to the mechanical hindrances offered by the prostatic obstruction, catheterization may present most serious difficulties.

In this event, one should first attempt to introduce an elbowed catheter No. 16 or 17. If this fails, force should not be applied and the

urethra caused to bleed, but the single elbowed catheter should be replaced by a *double elbowed catheter.* Success will often be obtained in this way.

If the last-mentioned device likewise fails, recourse may be had either to a rubber or woven catheter with prostatic curve (for the mode of introduction see p. 643), or to an ordinary soft rubber catheter mounted on an obturator, or, in some difficult cases, to the metallic washing-tube which is used for the aspiration of clots in litholapaxy (provided the condition of the urethral canal permits of its use).

In no instance should it be forgotten to have the patient's pelvis well elevated with a pillow, or more simply, by having him hold his closed fists beneath his buttocks.

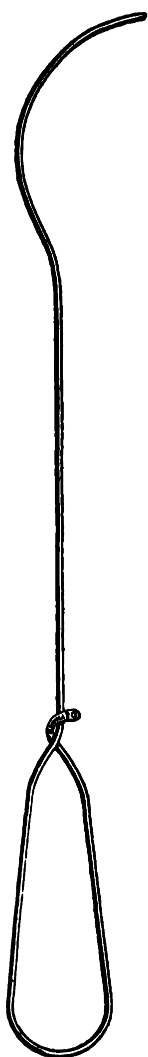


Fig. 197. Freudenberg's curved obturator.

Catheterization over an Obturator.—Guyon's or Freudenberg's obturator may be used. The latter is the more convenient to use. It consists (Fig. 172) of a thin metallic rod with a prostatic curve and with its proximal portion bent to form a loop, the end of the rod hooking around the shaft after the manner of a spring.

In using the obturator, the spring loop is loosened and the obturator is slipped into the lumen of the catheter, which thereupon assumes the curve of the obturator. Care should be taken to see that the point of the obturator is capped by the closed extremity of the catheter in such a way that it cannot come out through the eye of the catheter and wound the urethra.

The proximal loop-handle of the obturator, when sprung back over the catheter onto the shaft, will keep the catheter in its proper position on the obturator.

In introducing the catheter with its contained obturator, the procedure is the same as with an ordinary prostatic catheter (see p. 643). When penetration into the bladder has occurred, the instrument being in the natural position of the prostatic catheter horizontally in the median line between the patient's leg, and the operator feeling distinctly that the catheter is actually in the bladder, withdrawal of the obturator is proceeded with, while the catheter remains *in situ.*

For this purpose, the penis is kept well stretched in the median plane and the catheter simultaneously held with the fingers of the same hand; with the right hand the spring-loop is set free and the

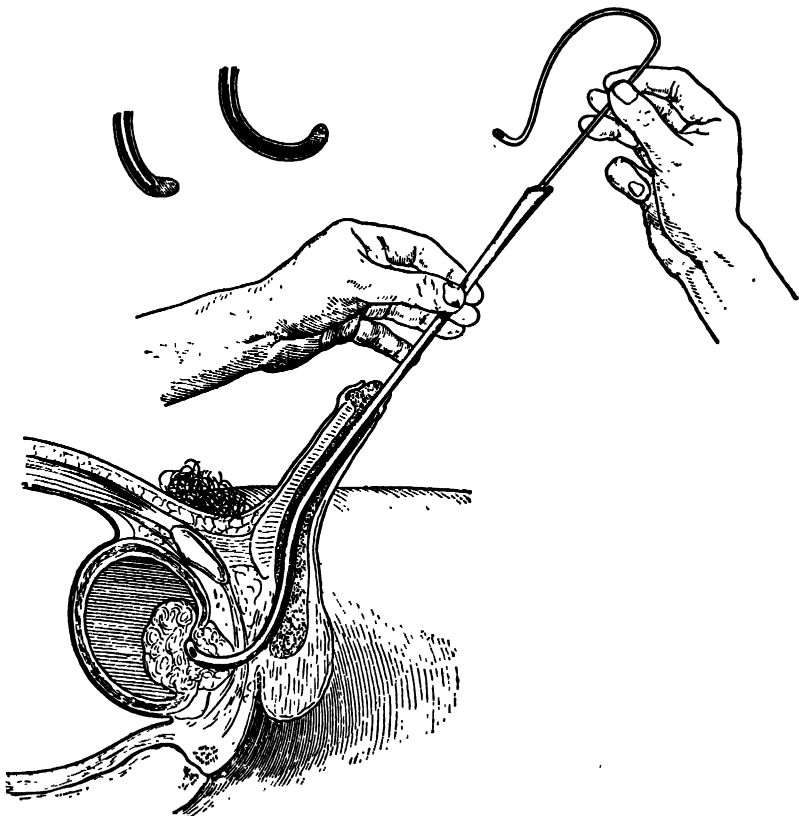


Fig. 198.—Catheterization over an obturator.

A little before the catheter reaches the obstacle, the obturator is immobilized while the catheter is pushed in with the left hand. Above, a diagram showing the effect of the obturator on the extremity of the catheter.

obturator then withdrawn following a course the reverse of that by which it had entered.

Evacuation of the distended bladder in a case of retention should never be completed at one time, lest hemorrhage *ex vacuo* result. If the catheter is to be left in—a wise proceeding—its outlet may be closed with

a plug, to be removed at intervals. A continuous flow should be allowed only after some hours, when decongestion of the bladder has been obtained.

The Retained Catheter.

The retained or indwelling catheter is indicated:

1. To place the bladder at rest.
2. To drain the bladder.

Placing the bladder at rest with the retained catheter is indicated:

1. In refractory bladder hemorrhage. 2. In the acute exacerbations of painful chronic cystitis. 3. In the urinary infection of prostatic cases.

Contraindications.—The use of the retained catheter should not be prolonged when it proves ineffective; when the blood and clots are constantly obstructing it and the patient is in distress, and when the fever fails to yield. Under these circumstances a *cystostomy* should be done and a large Marion tube inserted.

Selection of the Catheter.—In general, a good curved catheter is preferable to any other.

Its caliber varies according to individual circumstances, being, *e.g.*, No. 16 to No. 20 French.

Attention Required after Introduction of the Catheter.

(*a*) The proper functioning of the catheter should be kept under supervision; is the urine flowing out regularly?

(*b*) Evacuation of pus and clots should be facilitated by irrigations and, if necessary, by aspiration.

(*c*) If the catheter becomes blocked and functions poorly, it should be changed and, if necessary, replaced by a Lebreton catheter.

How often should the catheter be changed?

This depends on the rate at which it becomes foul and incrusted with lime salts—generally every three or four days, sometimes oftener.

How long can drainage with an indwelling catheter be continued?

In the major acute urinary infections, the indwelling catheter should soon give way to cystostomy if it fails to lower the temperature.

In chronic infections, rather prolonged use of the indwelling catheter may be required; usually, when proper drainage is not afforded by an ordinary catheter, recourse is had to the self-retaining catheters of Pezzer or Lebreton.

These catheters are introduced over an obturator.

Fixation of the Retained Catheter.—1. Care should first be taken that the catheter is exactly in the position required. The flow from it should be a constant, even drip.

2. The customary procedure in fastening the catheter in is to obtain two pieces of coarse darning cotton, each about 50 centimeters (18 inches) long. One of these threads is tied, at its middle, around the catheter over the meatus, after careful adjustment of the flow

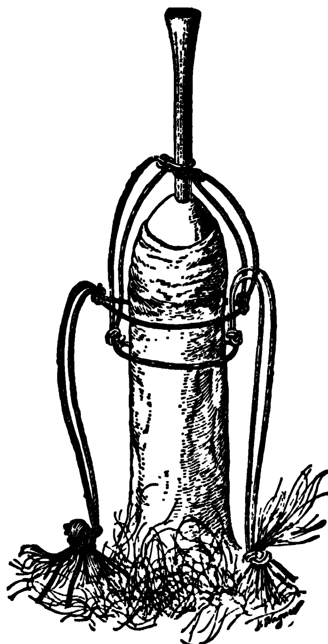


Fig. 199.—Fixation of the retained catheter (*Marion*).

of urine through the catheter. The two ends of this first thread are next knotted together at the side of the penis at a distance of 4 or 5 centimeters (1⅗ to 2 inches) from the first knot, just below the glans. The ends are then separated; one is carried in front of and the other behind the penis, and they are tied together on the opposite side of the organ. An initial ring about the penis is thus formed, and the two remaining ends, now united, are tied securely to a tuft of pubic hair.

The same procedure is then carried out with the other thread, after it has been tied around the catheter above the first thread. Its two ends are first taken to the opposite side of the penis, knotted

together below the glans, and at this juncture fastened to the initial ring by a knot.

The two ends are then separated to form a second ring parallel to the first below the glans and brought back on the opposite side of the penis, knotted together, and the resulting knot fastened again to the first ring; lastly, these two ends, brought together, are tied to another tuft of pubic hair.

A simple modification of this plan of fixation is to fasten to the penis, with zinc oxide adhesive plaster, the united ends remaining loose after the formation of the rings.

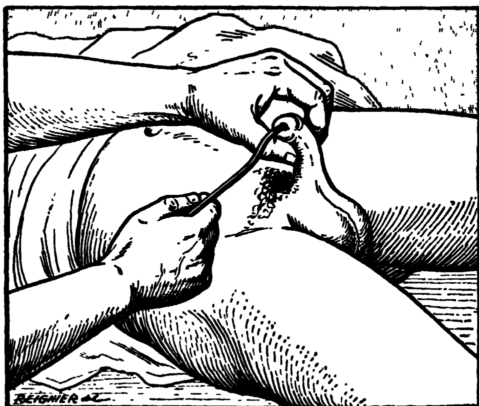


Fig. 200.—Introduction of the curved sound. First step.

Fixation by means of a species of rubber cap is also feasible and convenient.

III. CATHETERIZATION FOR PURPOSES OF DILATATION.—The main indication for this procedure is in the treatment of strictures by dilatation.

Dilatation of the urethra has for its object to improve the condition of the walls of the canal, soften them, and restore the urethral lumen. Its effect is exerted by its contact with the tissues. It should be carried out *slowly, progressively, in small, repeated dosage,* and not in an abrupt, forcible manner; in other words, the operator should confine himself to the passage of but a few sounds at each sitting and use only those which the canal will stand. Care should be taken to allow enough time between sittings (one or two sittings a week, at the most).

Instruments.—Either the rubber olivary bougies, graded in thirds of a millimeter, or the *metallic curved sounds,* graded in sixths of a milli-

meter. The curved sound is generally provided at its tip with a recess into which can be screwed a filiform conducting bougie; this greatly facilitates the passage of the instrument by those unaccustomed to its use.

Technic.—Dilatation with straight olivary bougies offers no serious difficulty. The main points are to insure proper antisepsis and to operate with great gentleness. The sound introduced must be one that will pass through all the strictured areas and enter the bladder, as indicated by the sense of freedom of the tip of the instrument.

At each sitting the size of the bougies is increased by one or two

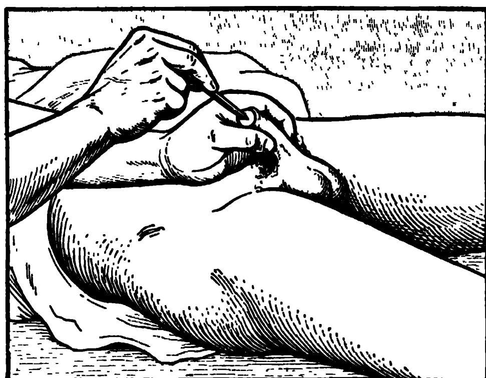


Fig. 201.—Introduction of the curved sound. Second step.

numbers. When No. 20 is reached the rubber bougies are replaced, as a rule, by the curved sounds.

Introduction of these sounds demands great gentleness of manipulation, to obviate all risk of making a false passage. The procedure should be carried out methodically, in accordance with well-established rules, and never by main force. The operator should allow himself to be guided, as it were, by the instrument.

The introduction of the curved sound comprises three separate steps:

The physician stands on the left side of the patient.

1. With the patient lying on the bed, with his buttocks raised, the penis is held up almost vertically by the left hand in a direction paralleling that of the inguinal furrow; with the right hand the instrument is inserted into the meatus and passed in as far as the bulb, with its concavity turned toward the operator. In some cases the traction on the penis in a direction parallel to the inguinal furrow has

to be pushed very far, and it is only when the instrument is felt to be well engaged in the urethra that the second step is proceeded with.

2. In the second step, the penis, still kept on the stretch, is gradually brought back to the median line and at the same time elevated slightly; the instrument passes in more deeply as the penis rises and gradually assumes a position almost perpendicular to the abdominal wall, in the median line.

3. At this juncture, the third step, which consists of the entrance of the catheter into the membranous urethra, takes place almost of

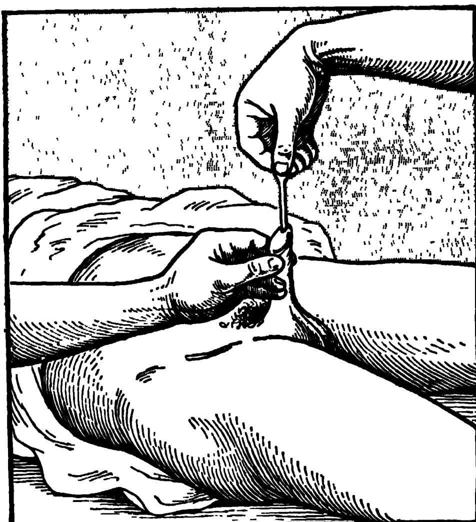


Fig. 202.—Introduction of the curved sound. Third step.

its own accord; the operator has but little to do in guiding the progress of the instrument. From the perpendicular position in the median line the instrument is brought downward and forward, with the penis still kept well extended, and penetration becomes definitely assured when the instrument has returned to a position between the legs of the patient (fourth step).

This at first somewhat difficult procedure becomes very easy with practice. It merely requires great gentleness and caution. If the operator is not quite sure of himself, it will be well for him to carry out the different steps very methodically, and if necessary, if he experiences some difficulty or inward trepidation, it will be of great assistance for him to use a conducting bougie.

Dilatation of the urethra with the curved sounds should be very gradual. At each sitting three sizes of sounds should be passed, always be-

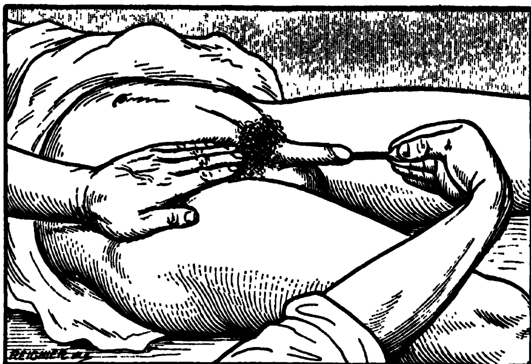


Fig. 203.—Introduction of the curved sound. Fourth step.

ginning with that last used at the preceding sitting. The dilatation should be carried out preferably with the bladder full and should be followed

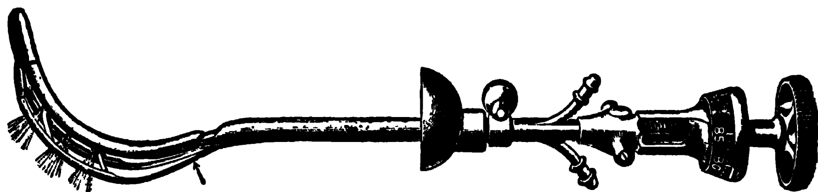


Fig. 204.—Kollmann's curved dilator.

by an antiseptic irrigation and, if necessary, by the instillation of a small amount of 2 per cent. argyrol or of protargol. It is well to advise the use of methenamine during the treatment.

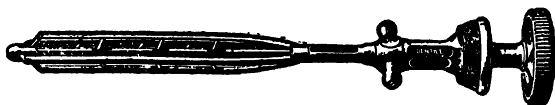


Fig. 205.—Kollmann's straight dilator for dilatation of the anterior urethra.

Dilatation with Irrigating Dilators.—These instruments are of two sorts: Some, modified from the old branched dilator of Voillemier, are of the curved type; these are the Kollmann dilators. Those made by Gentile, consisting wholly of pure nickel, are particularly

to be recommended. They are introduced like the curved catheter. The handle of the instrument being somewhat heavy, penetration occurs very easily; one has merely to keep the penis taut and almost follow the motion of the instrument. Sometimes there is advantage, at the moment of entrance into the membranous portion of the urethra, in pressing down the suprapubic tissues with the left hand.

When the instrument has entered the bladder, its branches are spread apart *gradually and very slowly* by means of the thumbscrew on the

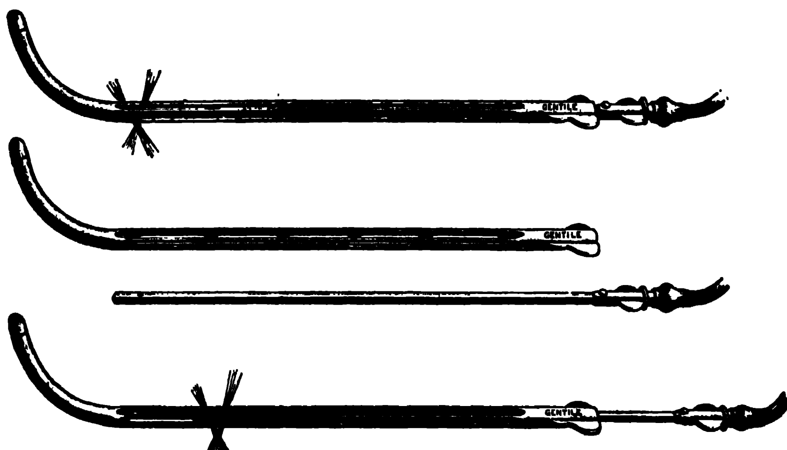


Fig. 206.—Jeanbrau's dilating irrigators.

handle. After dilatation up to the desired caliber has been carried out, irrigation may be practised by connecting the tube of a fountain syringe with the inlet tube provided on the handle of the instrument for this purpose. To withdraw the instrument, the thumbscrew is turned slowly in the reverse direction; the figures on the scale show the amount of existing dilatation. It is well not to close the instrument down entirely before withdrawing it; this will obviate the risk of pinching the mucous membrane.

Jeanbrau's dilating irrigators are simpler in construction. They are easily introduced; the procedure is, on the whole, that used in connection with the curved sound. Satisfactory lavage and dilatation of the canal are obtained by this means.

MASSAGE OF THE PROSTATE AND SEMINAL VESICLES.

Definition.—The word *massage* is misleading; one should speak, instead, of *expression of the prostate,* for the end sought in prostatic massage is to evacuate abnormal secretions from the prostatic glands, or pus from an abscess.

Technic.—The patient may either be recumbent on a bed or in the standing position, leaning forward. I prefer this second posture,

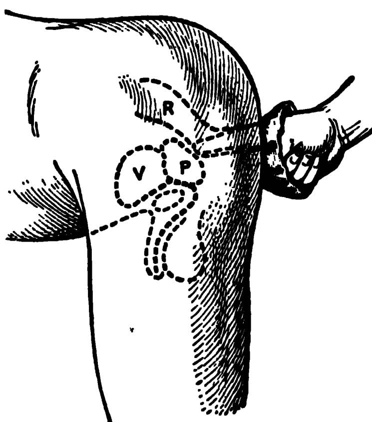


Fig. 207.—Digital examination of the prostate and seminal vesicles.

more used in America than the first, because, in my opinion, it allows of a more systematic examination of the prostate and especially of the seminal vesicles. It permits the physician to palpate higher up, particularly in stocky or stout patients, and also appears to me to give less chance for a back-flow of the secretion into the bladder.

The finger, covered with a rubber finger-cot and lubricated with petrolatum, is passed into the rectum with its pulp directed anteriorly. The condition of the different portions of the prostate is systematically examined.

The prostate may present a regular, uniformly smooth surface or, on the other hand, a nodular, irregular surface, and may be soft and depressible or hard (the latter, *e.g.,* in cancer). Palpation may prove painless or extremely painful. Pressure leads to the discharge

of a liquid of varying amount, consisting sometimes of only a few drops of secretion; at other times, the massage brings out a copious amount of milky secretion, removal of which affords distinct relief to the patient and decongestion of the prostate; lastly, in the presence of abscess, a considerable amount of pus, sometimes mixed with blood, may be caused to issue on pressure. Examination and massage of the seminal vesicles, too often neglected, are indispensable procedures. The vesicles often participate in prostatic inflammation; frequently, indeed, vesiculitis is of greater significance than prostatitis.

In order properly to explore the vesicles and empty them by pressure, the finger must be passed beyond the prostatic region. Careful examination permits of the detection of the residual foci of chronic infection of the vesicles and systematic expression may assist in their absorption. The exploration of the vesicles and prostate with the finger in the rectum may be combined with hypogastric palpation; in many instances, in patients with thin abdominal walls, such bimanual palpation yields better results than the finger in the rectum alone.

VIII

PROCEDURES RELATING TO THE DIGESTIVE TRACT.

By P. Desfosses, M.D.

I.—LAVAGE OF THE MOUTH.

Lavage of the mouth is a procedure which, by virtue of its mechanical action, antagonizes fermentative processes in the oral cavity and promotes its restoration to normal, or exerts a detergent effect according as the morbid condition present is of a medical or surgical nature.

Indications and Contraindications.—From the medical standpoint, lavage of the mouth is indispensable for the prevention of oral infections proper, such as ulcerations and thrush; of infections of the salivary glands, such as parotitis, and of sore throat and stomatitis.

In diphtheria particularly, the irrigations should be kept up during convalescence in order to favor the expulsion of germs which, because of their virulence, remain a constant source of danger to other persons.

In the realm of surgery, such irrigations are required in cases of injury to the tongue, gums, palate or cheeks, as well as after operations on the mouth.

Apparatus.—A glass fountain syringe, with its rubber tubing, a small nozzle, and a basin or bowl to receive the ejected fluid.

Warm, sterile water to which sodium borate has been added.

A towel and a folded sheet.

Preliminary Preparations.—The lips and gums should first be freed from sordes with pledgets of cotton moistened with Vichy water or some mildly alkaline solution.

Technic.—The patient is held in the sitting posture, with the head slightly bent forward; a towel or folded sheet is placed about the neck and over the chest, and a basin is held below the chin to receive the ejected fluid. The nozzle having been brought to a position opposite the patient's mouth, he is enjoined to breathe through his nose and open his mouth. The jet of fluid is then directed to the inner surfaces of the cheeks, the palate or the tongue, according to the

area affected. The water sweeps over the pharynx and runs out into the basin. After one or two liters of fluid have thus been projected into the oral cavity, the patient's lips and chin are wiped dry.

In children, generally hard to manage in this connection, irrigation of the mouth requires certain special precautions. Following is the procedure for the purpose:

The child is held on the knees of an assistant, who takes hold of his arms.



Fig. 208.—Lavage of the mouth, showing the position of the patient and the nurses, one of whom carries out the lavage while the other holds the patient.

The operator sits in front of the child, and the fountain syringe is arranged on a table and at an elevation of about 50 centimeters (20 inches) above the level of the mouth. The nozzle is either inserted directly between the teeth or, in case the child resists, in the vestibule of the mouth, in order that the jet of fluid may get in behind the teeth. The reflex thus brought into action causes the child's mouth to open, and advantage of this is at once taken to slip the nozzle between the teeth. The child's head should be tilted slightly forward, and the jet of fluid should be strong enough so that it will not be swallowed but will run out again into the basin. The stream should

be interrupted at short intervals to allow the child to get his breath, and care should be taken to direct it to the right and left over the tonsils and against the pharynx, the hard and soft palate being, however, avoided. The amount of water required for the procedure is from 1 to 1½ liters.

Untoward Accompaniments.—No unpleasant effects are to be expected. At most, the patient may experience reflex nausea brought on by the impact of the fluid on the uvula. Interruption of the procedure for a few seconds will cause it to disappear.

II.—CATHETERIZATION OF THE ESOPHAGUS.

Catheterization of the esophagus has for its object the introduction into the stomach through the mouth or the nasal passages of a soft or hard rubber tube for purposes of examination, treatment or feeding.

Indications and Contraindications.—Through the mouth, this procedure is employed in the medical treatment of stomach disorders, such as gastric stasis, and for obtaining samples of the gastric juice (see the next section). Through the nose, it is availed of in patients who have been subjected to operations on the mouth, such as resection of the maxillary bones, suture of the mandible, and removal of the tongue for tumor. Tight closure of the jaws, of whatever cause, may lead to the use of this form of catheterization. It is also indicated in insane patients who refuse all food. Under these circumstances it obviates the necessity of forcibly separating the jaws—often a difficult and dangerous procedure.

It is absolutely contraindicated in cases of hematemesis in which red blood is brought up in more or less copious amount, or where aortic aneurism is suspected. (In the latter contingency, the radial pulse on the two sides should be compared and the midsternal and dorsal regions percussed and ausculted.)

Apparatus.—An esophageal tube about 90 centimeters (3 feet) long and with a diameter of 6 to 8 millimeters (¼ to ⅓ inch) is required. It should be flexible, yet possess a certain degree of rigidity; its walls should be smooth; its lower end should be provided with lateral openings and its upper end expanded to facilitate the introduction of a funnel.

There should also be at hand: A funnel; some milk or sterile oil to lubricate the tube (the oil in case the nasal route is to be used); a folded sheet; a bowl, and if feeding is intended, some liquid food.

The latter may consist of bouillon with the addition of egg yolk, or milk mixed with chocolate. A frequently used mixture is the following:

Milk	½ to 1 liter (quart);
Egg yolks	2.

This is to be given twice daily.

Other articles needed are: A 2 per cent. solution of cocaine; a pledget of cotton, a pair of forceps with the handle bent at an angle, and a tongue-depressor.

Preliminary Preparations.—The patient should be seated and his chest covered with a sheet fastened behind his neck. The pharynx may be anesthetized, if necessary, by application of the cocaine solution twice at an interval of two minutes.

The patient's head should be held, and if he is an insane subject, the straight-jacket used. The distal end of the tube should be softened between the fingers and a slight bend made in it so that when it comes in contact with the posterior pharyngeal wall it will curve down more easily.

Technic.—The path to be followed by the tube is as follows: After being introduced through one of the nostrils, it should follow the floor of the nasal cavity. When it reaches the posterior surface of the soft palate, it bends at a right angle to follow the posterior pharyngeal wall and, after escaping the upper opening of the larynx —often a stumbling-block—passes easily down in the esophagus.

With the patient's head immobilized and the tube suitably bent and lubricated with sterile oil, the tube is lightly taken hold of with the thumb and forefinger, inserted in one of the nostrils, and then slipped along the floor of the nose. If congenital narrowing or deviation of the septum exists on the side first selected, and trouble is experienced in passing the tube, the latter should be reinserted on the opposite side. As a rule, the tube passes in quite easily and impinges against the posterior wall of the pharynx. Pushed in further, gently but persistently, it should bend at a right angle and pass down. If the patient is conscious, he should be requested to make swallowing movements; these facilitate the progress of the tube, which ordinarily descends by its own weight through the esophagus without exciting nausea.

The tube having been introduced in its entire length, the liquid is poured gently into the funnel previously inserted in the upper end of the tube. The fluid passes down by gravity. When all of it has passed in, the end of the tube should be closed with the thumb while

the tube is being withdrawn; otherwise the remnant of food in the tube would gradually escape from it, and might enter the larynx.

Untoward Events and Complications of Catheterization through the Nose.—*Epistaxis* due to tears of the mucous membrane or the turbinates. If it is slight, little attention need be paid to it.

Introduction of the tube into the mouth.—The tube should be withdrawn and the procedure repeated.

Introduction of the tube into the respiratory tract.—This is somewhat serious, but is noticed immediately. The patient loses his voice and exhibits an asphyxic hue. All that is necessary is to draw the tube

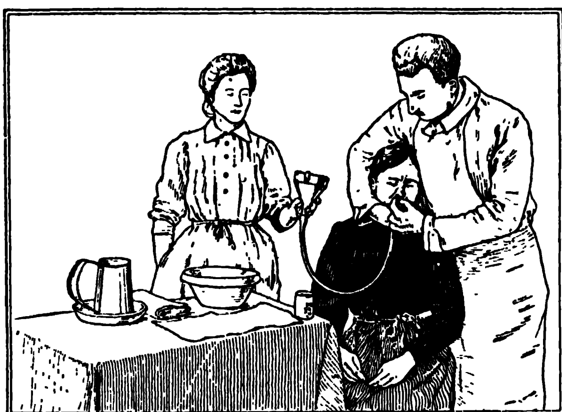


Fig. 209.—Introduction of esophageal tube by the nasal route (DIDE and GUIRAND).

out a few centimeters and make a second attempt to get into the proper channel. In the case of a comatose patient or one with anesthesia of the pharyngeal and laryngeal region, in which there is the least suspicion that the tube may have passed into the trachea, one should, to be certain before pouring in the liquid food, close the outer end of the tube with the thumb, when the patient, receiving no air, will show evidences of asphyxia; or, a little water may be injected, bringing on cough if it passes into the larynx.

III.—LAVAGE OF THE STOMACH.

Gastric lavage has for its object to introduce repeatedly into the stomach and remove from it water or medicated solutions through a stomach tube.

Indications and Contraindications.—Lavage of the stomach is an important procedure.

1. *Medically,* carried out on an empty stomach, it constitutes a most useful procedure for disclosing an organic stomach lesion. It often proves of service in permanent stomach stasis, caused in particular, by pyloric stenosis of whatever origin. In cases of *poisoning* by the gastric route, the first measure is to practise repeated and copious gastric lavage.



Fig. 210.—Apparatus for gastric lavage.

2. *Surgically,* it can be employed either before or after an operation on the stomach, either to prepare the patient or to insure, for the time being, gastric evacuation after the operation.

Lavage is contraindicated in hematemesis and in aortic aneurism.

Apparatus.—The tube should be of red rubber, soft, strong and smooth, with a black mark corresponding to the average depth of the cardiac orifice, *viz.,* 50 centimeters (20 inches).

The other articles needed comprise a funnel, a rubber apron or a folded sheet for the patient's protection, a pail, a cuspidor and some cold boiled water.

Preliminary Preparations.—The patient is made to sit down, the rubber apron or sheet fastened around his neck, and the cuspidor placed near him.

Technic.—The end of the tube is dipped in milk or a very dilute alkaline solution, the patient's head inclined forward slightly, and the end of the tube rested on the patient's tongue. Verbal encouragement is given, the patient urged to breathe normally and perform swallowing movements, and the tube pushed in gently so that it gradually passes down through the esophagus and enters the stomach. Some patients are able to carry out this maneuver by themselves.

As soon as the mark 50 centimeters from the end of the tube has reached a point between the patient's lips, ½ liter (1 pint) of water,



Fig. 211.—Gastric lavage in the recumbent posture (*L. Meunier*).

at most, is poured into the funnel, which is then raised above the patient's head. The water passes down rapidly, and when the funnel is almost emptied it is quickly lowered below the level of the stomach and above a pail placed in position for the purpose.

The tube is withdrawn after pinching it firmly opposite the teeth to keep the water remaining in it from running out, and drawing it up at first slowly, then quickly, to forestall the reflex nausea.

It is generally preferable, as pointed out by Léon Meunier, to evacuate the stomach with the patient lying face downward (see "*Clinical Diagnosis*," p. 56).

The patient lies down on his abdomen, preferably on a horizontal table, with a cushion under the epigastric region. The patient is given a glass of water to drink. The physician, placing himself on the right side of the patient, then carries out the introduction of the tube, the right hand pushing it in while the left guides it. As soon as the tube reaches the gastric cavity, the smaller branch of the

syphon, by reason of its horizontal position, becomes filled spontaneously and the gastric fluid flows out freely.

Untoward Events.—*Smothering* of the patient by a profuse secretion of saliva flowing toward the larynx. This complication is obviated by keeping the patient's head bent forward. The saliva will then run out at the labial commissures and is received in the cuspidor.

Reflex nausea with retching. This can be remedied by applying cocaine solution in the pharynx or by gargling with 5 per cent. potassium bromide solution.

Incomplete lavage.—In cases with pronounced gastric dilatation the lavage may not have been thorough. When the clinical evidences (splashing sounds over an extensive area below the umbilicus) point to a markedly dilated stomach, from 10 to 12 centimeters (4 to 5 inches) should be added to the ordinary length of the tube. The latter should be introduced cautiously.

The tube may become blocked during evacuation of the residual food. In this event the operator should try to force the contents of the tube down again by adding a little water in the funnel; if this fails, the tube should be withdrawn and cleaned out with a strong stream of water.

Hemorrhage discoloring the wash water is preferably met by discontinuing the procedure.

Injury to the mucosa is rare. In the presence of evidences which might cause some apprehension of it, the tube should be withdrawn more gently and no aspirating devices used.

Dyspnea may be noted in old emphysematous and arteriosclerotic patients. The procedure had best be interrupted if it is the first sitting.

After-care.—The patient should be kept at rest. In the event of hemorrhage, ice should be applied externally or cracked ice given to the patient to swallow.

IV.—DUODENAL INTUBATION.

By André Lutier, M.D.

Duodenal intubation, utilized chiefly for clinical diagnosis, has lately been introduced into the domain of therapeutics, first by the Americans, then in France.

Apparatus.—The duodenal tube consists of a metallic olive of 23 millimeters' circumference, hollow and perforated with several holes, This olive is connected with a pliable rubber tube measuring 1 meter in length and 3 to 4 millimeters in diameter. A silk thread fastens the olive to the tube.

On the tube are three marks, placed, respectively, 40, 56, and 70 centimeters from the olive. Theoretically, the olive is at the cardia when Mark I is in a line with the teeth; near the pylorus at Mark II, and in the duodenum at Mark III.

For duodenal feeding, Einhorn has had constructed a special apparatus shown in Fig. 212: The mixture of food is placed in a receptacle; a 3-way tap, fastened over the cover, permits of aspiration of the mixture into a syringe and of then discharging it into the duodenal tube.

There may just as well be used, for the same purpose, a glass syringe of large caliber or a funnel inserted into the outer end of the duodenal tube.

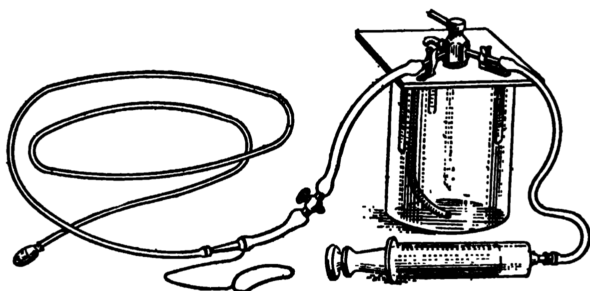


Fig. 212.—Max Einhorn's apparatus for duodenal feeding. The two-way cock allows of alternate aspiration of the fluid from the glass into the syringe and injection of this fluid from the syringe into the duodenum.

Technic.—Reassuring words should be spoken to the patient, in order to facilitate the operation and prevent spasm.

The patient is seated, and himself passes the olive, moistened with water or milk, to the pharynx. Swallowing a few mouthfuls of liquid will assist in the introduction. The isthmus of the pharynx having been passed, the tube will of its own accord descend into the esophagus, the patient helping with a few swallowing movements. The progress of the tube should be slow, in order to obviate its doubling up on itself. After ten or fifteen minutes the olive will generally have reached the vicinity of the pylorus, Mark II appearing on a level with the teeth.

The patient now lies on his right side, with the buttocks slightly raised by a cushion and the thighs flexed on the pelvis. About 1½ hours after the start of the procedure the olive is in the second part of the duodenum, Mark III being in line with the teeth.

To ascertain if the olive is actually in the duodenum, a little fluid is aspirated with a syringe.

If the fluid comes from the stomach it is colorless, of a dirty appearance, mixed with large air bubbles, and is acid to litmus.

If it comes from the duodenum, it is golden yellow, clear, homogeneous, slightly viscid, and alkaline or neutral. This test, however, is not conclusive; the olive, even though it has remained stopped in the stomach, may allow the passage of a yellowish fluid from biliopancreatic regurgitation. On the other hand, even with the olive actually in the duodenum, a golden yellow fluid, but of acid reaction, may be withdrawn, the gastric fluid not having yet been neutralized in the duodenum, or reaching there continuously through an incontinent pylorus.

The marks on the tube are not to be depended on, as the tube may be kinked.

Milk or wine may, in addition, be fed through the tube; and if the olive is in the stomach, these liquids can be immediately withdrawn again.

The most dependable procedure, however, is fluoroscopic examination, which permits of actually seeing the tube and the olive *in situ*.

Withdrawal of the tube is easy, gentle traction on it sufficing.

Impediments.—In some nervous subjects, a pharyngeal spasm prevents swallowing of the olive. This can be remedied by a preliminary local application of a 1:30 cocaine solution.

Very occasionally a spasm of the cardia arrests the tube; preliminary ingestion of belladonna is said to obviate this.

The most frequent obstacle is at the pylorus, either because of the tube becoming knotted in the stomach, the patient having swallowed the tube too quickly; because of gastroptosis with atony (in which event the patient's buttocks should be well elevated with cushions), or, more frequently, because of pyloric spasm (organic stenosis is, in general, clinically recognized and has contraindicated the duodenal intubation).

In this latter case, if the characteristic duodenal fluid has not been obtained in three hours, the physician should not persist, but should postpone the intubation to another time.

Untoward Effects.—Duodenal feeding or lavage sometimes induces rather severe colicky pain. For this reason it is well to inject the fluids warm and, if necessary, to inject beforehand a few drops of tincture of belladonna.

Indications.—Duodenal intubation, in therapeutics, serves principally for duodenal feeding. The latter is carried out, according to Einhorn's method, by giving every two hours 200 grams of sweetened milk with which has been mixed the yolk of one egg; broths, meat juice, saline solution, etc., may likewise be administered.

Prof. Carnot recommends the duodenal drip method.

The tube may be left in place for two or three weeks, by tying its free end to the patient's ear.

Duodenal feeding is indicated in gastro-duodenal ulcer, in order to insure rest of the diseased organ, and in hemorrhages, especially the small, repeated hemorrhages, gastric or duodenal, which render the patient anemic. Mental anorexia with uncontrollable vomiting is another important indication.

The Americans have recommended duodenal instillations of solutions of protargol, argyrol, etc., in cases of duodenitis, cholecystitis, amebic dysentery, etc.

In diseases of the biliary tract with stasis and chronic infection, it is possible, by means of duodenal intubation followed by irrigations daily or twice weekly with, *e.g.,* 75 c.c. of 33 per cent. magnesium sulphate solution, to obtain a medical drainage of the bile-passages which, it is claimed, will obviate the need of surgical intervention.

V.—RECTAL IRRIGATION.

This consists of the injection into the rectum and colon of a more or less considerable amount of fluid in order to procure remedial, evacuant or other effects.

Indications and Contraindications.—The indications are:

Constipation (simple or oil enema).

Fecal obstruction (enteroclysis).

Dehydration following hemorrhage or severe infections (Murphy's proctoclysis).

Gastric intolerance (nutritive and medicinal enemas).

Affections of the rectum or other pelvic organs, *e.g.,* hemorrhage, prostatitis, or metritis (hot enema at 40° C.—104° F.).

The contraindications are: Inflammatory abdominal conditions demanding absolute rest—appendicitis, intestinal hemorrhage, peritonitis.

Apparatus.—For the ordinary enema: A glass irrigating jar, a rubber tube 1½ meters (5 feet) long, and a nozzle of glass or hard rubber. In children: A soft bulb-syringe.

For enteroclysis: A 2 liter (quart) irrigating jar or 1 liter funnel; plenty of warm water, and a rectal tube of red rubber, thick-walled

and 30 or 40 centimeters (12 to 16 inches) long. In children: A No. 25 red rubber urethral catheter.

For Murphy's proctoclysis: A graduated glass receptacle of 500 c.c. (1 pint) capacity, covered with cotton to retain the warmth of the contained fluid during the injection; a tube provided with a stop-cock in good working order; a rectal tube.

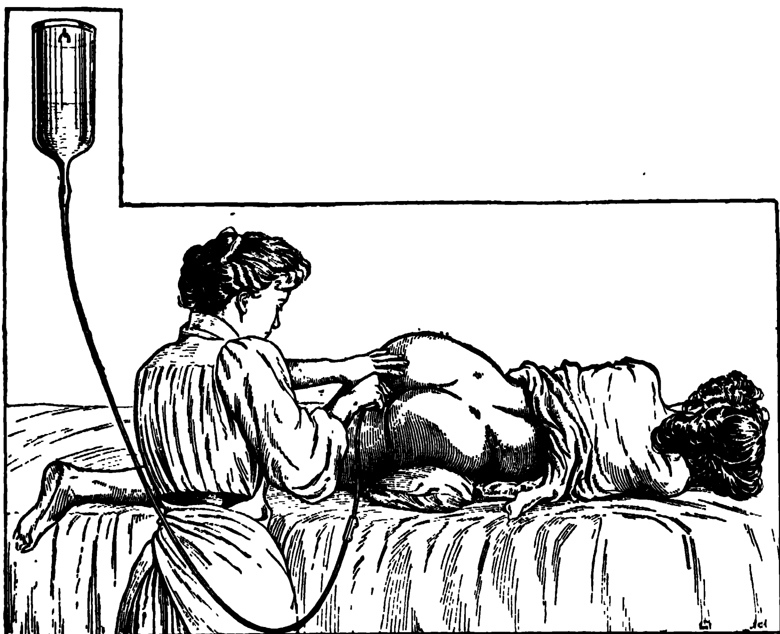


Fig. 213.—Procedure in administering an enema from an irrigating jar, with the patient lying on the right side.

Medicinal or nutritive enemas: The ordinary glass irrigating jar or 100 c.c. (3 ounce) glass syringe and a nozzle of hard or soft rubber.

Preliminary Preparations.—The bed should be protected with a folded sheet, and the nozzle or catheter lubricated with olive oil or petrolatum.

Technic of the Ordinary Enema.—Right lateral decubitus is the customary posture; but an enema can be administered in left lateral decubitus or, if moving of the patient is inadvisable, in dorsal decubitus.

Assuming that the patient is lying on the right side, the pelvis should be elevated on a cushion; the thighs, especially the left,

drawn up slightly, and the trunk bent forward to relax the abdominal muscles.

The nozzle, lubricated with some oily substance, is introduced in the anus in the direction of a line extending from the anus to the umbilicus, for a distance of 2 or 3 centimeters (4/5 to 1 1/5 inches). It is then inserted backward in order to follow the curve of the rectum. The nozzle should be introduced without any force. It should pass up beyond the sphincters in order that the fluid shall enter the rectum and not be ejected. The nozzle having been inserted, the receptacle is raised to a height of 40 centimeters (16 inches) above the surface of the bed; when the fluid has started to flow in, it is raised to 1 meter (3 feet) until 1/2 liter (1 pint) has entered (small enema) or 1 liter (quart) (large enema). After the enema has been given, the patient lies on his back. Evacuation takes place within a short time.

To the simple enema, given lukewarm (34 to 37° C.—93.2 to 98.6° F.) or warm (39 to 45°—102.2 to 113° F.), may be added, in obstinate cases due to rectal atony, a little glycerin (two or three spoonfuls) or, if a laxative effect is desired:

℞ Sennæ,
Sodii sulphatis ....āā 10 grams (ʒiiss);
Decocti altheæ .... 300 c.c. (f℥x).

Ft. sec. art.
Sig.: To be administered as an enema and retained.

If a purgative effect is required, the amount of sodium sulphate should be doubled or trebled:

℞ Sennæ .... 10 grams (ʒiiss);
Sodii sulphatis .... 30 grams (℥j);
Decocti altheæ .... 300 c.c. (f℥x).

Ft. sec. art.
Sig.: To be administered as a purgative enema.

Enteroclysis.—The patient should be placed across the bed in the lithotomy position and the lower extremities covered to avoid exposure to cold. The pelvis should be tilted to the right by slightly elevating the left hip.

Petrolatum is applied to the anal region, and the soft tube introduced along the forefinger up to the rectal ampulla. The insertion should be proceeded with slowly and gradually, the fluid being allowed to flow and unfold and open out the bowel in advance of the tip of the rectal tube. The latter should be caused to pass in up to the middle of the transverse colon, *i.e.*, for a distance of 30 to 40 centimeters (12 to 16 inches). The irrigating jar should then be raised 40 centimeters above the surface of the bed and later gradually up to 75 or 80 centimeters (30 or 32 inches).

In a child, 2 liters (quarts) may be allowed to flow in; in an adult, 4 to 6 liters. Pressure should be made on the anal tissues around the tube with cotton pledgets.

The tube is then rapidly withdrawn and the patient placed in dorsal decubitus. Rather sharp cramps appear, followed by the passage of gas and fecal material when the procedure has been successful. Sometimes several hours elapse, however, between the passage of gas—a favorable indication—and the free discharge of feces.

If the procedure fails, it should be repeated once and the electric intestinal douche tried before resorting to operative intervention.

Murphy's Proctoclysis.—In this procedure one may use either physiologic salt solution or 3 per cent. glucose solution, with addition of caffeine, 0.1 per cent., or adrenalin, 10 to 20 drops of the 1:1000 solution to the liter. The fluid decided upon should be placed sufficiently hot in the receptacle, the latter being, furthermore, protected with a cotton-padded covering. If necessary, the fluid should be warmed up from time to time.

The stopcock should be adjusted to give a flow of one drop every second, *i.e.*, about 200 c.c. (6⅔ ounces) every hour, or of one drop every two seconds, *i.e.*, about 100 c.c. (3⅓ ounces) every hour.

The receptacle should be at a low elevation—50 centimeters (20 inches). The amount of fluid delivered should be carefully watched. The patient should be in a slightly inverted position, such as would result from placing a brick under the feet of the bed.

The tube should be inserted rather deeply (30 centimeters—12 inches). If it tends to escape from the bowel, it should be held in place with a bandage fastened to a belt. If the patient is restless, he should be kept under watch.

The procedure should be interrupted for a half hour every two hours, and repeated until 1200 to 1500 c.c. (40 to 48 ounces) of fluid have been absorbed in the twenty-four hours.

Nutrient Enemas.—A simple cleansing enema should first be given, to be followed by the nutrient enema. A soft rubber tube should be introduced to a depth of 30 centimeters (12 inches) and the solution ordered injected with a syringe or from a receptacle at a slight elevation.

A suitable mixture is:

Warm boiled water	200 c.c. (f℥viss);
Glucose	20 grams (℥v);
Sydenham's laudanum (tr. opii crocata, N. F.) ..	10 to 15 drops;
Dry peptone	1 teaspoonful.

Or:

Milk,		
Bouillon .... of each	50 c.c.	(f℥iss);
Rum	30 c.c.	(f℥j);
Yolk of egg	1	
Peptone	5 grams	(gr. lxxv).

Such a mixture should be administered two or three times in twenty-four hours, in conjunction, if need be, with hypodermic injections of olive oil and physiologic salt solution. This procedure is indicated, *e.g.*, in cases of hematemesis or after surgical operations on the stomach.

Medicinal Enemas.—Chloral hydrate, bromides, etc., when given by rectum, should be prescribed in 100 c.c. (3 ounces) of fluid to obviate irritation of the mucous membrane. Insoluble drugs should be made into a suspension with yolk of egg.

The Olive Oil Enema.—This is used in obstinate constipation. The amount to be given is about 200 c.c. (6 ounces). The oil should be warmed; this makes it more fluid and facilitates its passage through the injecting device (fountain syringe or bulb-syringe). The patient should be placed in a slightly inverted position and requested to take a few deep breaths, which seem to facilitate the introduction of the fluid.

Defecation follows in a few hours, or only after twenty-four hours in patients markedly habituated to the procedure.

The larger amounts, such as 200 to 250 cubic centimeters (6 to 8 ounces), should be given only to patients who are in bed in the daytime, on account of the involuntary evacuations of oil which may occur.

Astringent Enemas.—The technic is the same as in the preceding varieties. The following astringent enema may be ordered:

Extract of gambir	2 to 5 grams	(gr. xxx-lxxv);
Decoction of althea	100 c.c.	(f℥iij).

Antiseptic Enemas.—These involve the introduction of ½ liter (1 pint) or more of a solution of zinc sulphate, copper sulphate, or sometimes silver nitrate or potassium permanganate. Only weak solutions, such as 1:500 zinc sulphate or copper sulphate and 1:10,000 potassium permanganate, should be used at first, and the strength of solution should be increased only slowly and gradually.

A vermicidal enema for children may be made by mixing a solution of 4 grams (1 dram) of salt in 300 c.c. (10 ounces) of water with 30 c.c. (1 ounce) of codliver oil.

Untoward Events.—These are of little practical importance. Occasionally an enema may not be expelled, the bowel having been overdistended by an excess of fluid and lost its contractility. A tube inserted in the rectum will enable the fluid to run out easily.

Strong contractions of the intestinal walls, resulting in cramps, may be produced.

Introduction of an enema may be rendered difficult by reason of the presence of hemorrhoids or of a fissure which is causing contraction of the anal sphincter. In such cases hot applications should be made or a cocaine suppository inserted. Tumors of the uterus or prostate may also constitute an obstacle and the tube should be gently curved around them; in these cases injection of a little water will facilitate the introduction.

After-care.—The utmost cleanliness is desirable. A cotton tampon should be inserted in the anus after oily, medicinal or nutrient enemas.

V.—HEMORRHOIDS.

Dilatation of the anus is indicated in anal fissures and in some cases of hemorrhoids.

A purge should be given two days before the operation, an enema on the preceding day, and a pill of extract of opium on the morning of the same day.

The patient is anesthetized. The operator inserts both of his thumbs, with their dorsal surfaces in contact, into the anus, and with a series of short, gradual movements, draws them apart, the other fingers securing a purchase on the buttocks, until the thumbs come in contact with the ischia.

On the same evening and the next day the patient is given 0.05 to 0.1 gram (¾ to 1½ grains) of extract of opium to prevent bowel action.

On the fourth day he is given a purge.

Removal of Hemorrhoids.—In painful, but small hemorrhoids, the treatment may be restricted to simple dilatation. In painful, large, bleeding hemorrhoids, however, excision is indicated.

Whitehead's operation, consisting of the removal by dissection of a cuff of mucous membrane including the entire inner lining of the sphincteric tract, is generally an unnecessary and dangerous procedure, sometimes followed by stricture of the anus. At all events, the practitioner should never venture to perform it.

Dilatation of the anus, followed by removal of the largest masses of hemorrhoids, generally suffices to cause all the piles to disappear. After the anus has been dilated, the anal mucosa is drawn out with forceps and the most prominent masses, forming three, four, or rarely five principal elevations, are located. One of these masses is seized with Kocher forceps; with a slightly curved needle it is transfixed with strong but pliable No. 1 catgut, and with this catgut the two



Fig. 214.—Dilatation of the anus.

halves of the hemorrhoidal mass are ligated in succession with a persistently and strongly tightened knot, guarded by two other superimposed knots. There is thus obtained above the knots a kind of varicose polyp of the size of a large bean. The same procedure is gone through with the other hemorrhoidal masses. These masses are then cut through with the cautery above the catgut. The bowels should be kept inactive for a week with extract of opium. A purge is then given. Within two weeks no remaining trace of the operation can be found. The patient is cured.

IX

PROCEDURES RELATING TO THE NERVOUS SYSTEM.

I.—LOCAL NEUROLYTIC INJECTIONS IN TRIFACIAL NEURALGIA.

SICARD'S TECHNIC.

The procedure of local neurolytic injection has for its object the destruction of the main trunks, branches and nerve filaments of the trigeminal nerve concerned in the pain by means of a selectively acting fluid introduced deeply in direct contact with the nerve tissue.

Instruments.—These comprise: (1) A set of platinum needles 0.7 to 0.8 millimeter in diameter and 3 to 6½ centimeters (1⅕ to 2⅗ inches) long. (2) Two ordinary 2-c.c. glass hypodermic syringes.

Solution to be Injected.—Sicard recommends either a 30 or 40 per cent solution of phenol in glycerin or a solution of the following composition:

Alcohol (80 per cent.) .... 20 c.c. (f3v);
Menthol,
Novocaine ....of each 0.2 gram (gr. iij).

Each of these solutions has its own separate indications. The phenol-glycerin solution is used for injections in large foramina and notches and the alcoholic solution in canals and small foramina on account of the penetrating power of the alcohol.

General Rules Applicable to the Procedure.—Before any attempt at treatment the operator should study the bones of the face and make preliminary tests in the cadaver with colored solutions.

At the time of the operation: (*a*) The skin should be disinfected with tincture of iodine; (*b*) it should be anesthetized with cocaine.

The amount used of either the phenol-glycerin or the alcoholic solution should, on an average, not exceed 1 c.c. (16 minims).

Not more than one nerve distribution should be injected at a sitting.

Intervals of five to eight days should be allowed between injections.

Technic.—The procedure varies according to the foramen or canal to be injected.

I. **Neuralgia of the Ophthalmic Division.**—SUPRAORBITAL AND NASAL NERVES.—Local anesthesia is first instituted at the foramen or notch with procaine (novocaine) and a few drops of procaine solution are then injected in the cellular tissue of the bony roof of the orbit to reach the branch of the supraorbital nerve. The needle is left *in situ;* the procaine syringe is replaced by the syringe containing the neurolytic solution and 1 cubic centimeter of the latter is injected.

Immediately after, supraorbital anesthesia should be tested for; it should be complete.

II. **Neuralgia of the Superior Maxillary Division.**—*A.* SUPERIOR MAXILLARY TRUNK.—To reach the main trunk of the superior maxillary, the needle should be directed toward the *foramen rotundum.* A needle 6½ centimeters long is used. Its point should be introduced below the malar bone and pass between the coronoid process and the posterior aspect of the superior maxillary bone. One cubic centimeter of 30 per cent. phenol-glycerin solution is to be injected in the cellular tissue of the pre-pterygoid fossa. If the injection is successful, the resulting anesthesia involves the half of the lip on the same side, the posterior two-thirds of the ala nasi, half of the palatal vault and the upper series of teeth on the corresponding side.

B. INFRAORBITAL NERVE.—A needle with a short bevel and 4½ centimeters (1⅘ inches) long should be selected. The needle is introduced directly alongside the posterior portion of the ala nasi. It is pushed in obliquely upward and slightly outward. It should travel within the infraorbital canal for a distance of about 1 centimeter (⅖ inch), *with caution,* as the bony floor of the orbit is often thin.

One and a half cubic centimeters of the alcoholic solution should be injected. The anesthesia should extend to the entire half-lip, the posterior two-thirds of the ala and the two anterior incisors on the same side.

C. POSTERIOR PALATINE NERVE.—The needle should be a curved one, screwed onto the syringe. It should be introduced slightly in front of the osteo-fibrous boundary of the palate, far back on the palatal vault, grazing the dental arch. It should be made to travel upwards for about 1 centimeter (⅖ inch). One cubic centimeter of the alcoholic solution is to be injected. The entire half of the palatal vault at once becomes anesthetic.

III. Neuralgia of the Inferior Maxillary Division.—*A.* INFERIOR MAXILLARY TRUNK.—A needle 5½ centimeters (2¼ inches) long should be selected, and directed toward the *foramen ovale.* It should be introduced in the small space existing between the zygomatic process and the intercondylocoronoid notch of the inferior maxillary bone. The deep landmark is the *pterygoid process,* at its postero-superior border. The needle should come to a stop against the resisting plane of the pterygoid, and then be directed backward in the upper post-pterygoid cellular tissue. One cubic centimeter of 40 per cent. phenol-glycerin solution is to be injected.

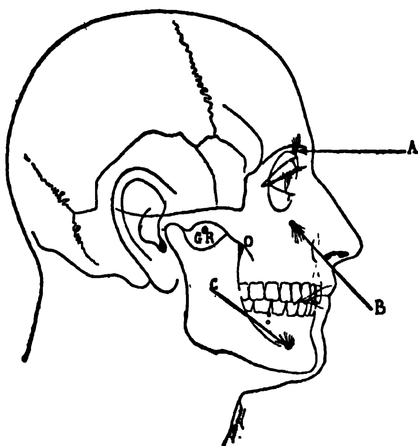


Fig. 215.—The peripheral orifices.

A, supraorbital nerve. *B,* infraorbital nerve. *C,* mental nerve. The direction of the arrows is that to be followed by the needle in reaching these orifices. The points *O* and *GR* mark the areas of access for a needle seeking the foramen ovale or the foramen rotundum (*Sicard*).

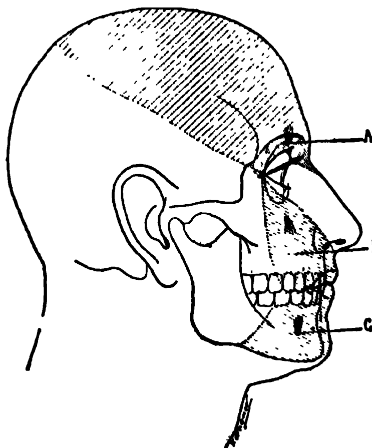


Fig. 216.—Diagram of the areas of cutaneous anesthesia resulting from neurolytic injection of the peripheral orifices:

Supraorbital (*A*), infraorbital (*B*), mental (*C*). After injection of the deep foramen rotundum and foramen ovale, respectively, the areas of skin anesthesia *B* and *C* extend slightly; but in addition, the anesthesia involves the corresponding half of the tongue and of the palatal and buccal mucous membrane and sometimes even the lower third of the skin of the ear. The unshaded nasal area is anesthetized only upon injection of the nasal nerve (*Sicard*).

The anesthesia should involve the anterior two-thirds of the mucous membrane on the corresponding half of the tongue, the half of the buccal mucous membrane, the inferior dental arch on the same side and the skin over one-half of the chin.

B. MENTAL NERVE.—A short-bevelled needle, 3 centimeters (1⅕ inch) long, should be used. It should be introduced downward and slightly inward in the mental foramen, the external landmark of which is located 4 centimeters (1⅗ inches) lateral to the median line of the chin and 1 centimeter (⅖ inch) above the lower border of the inferior maxillary bone (Sicard).

Immediate Untoward Results.—*Pain* is a constant effect, but does not last long.

Injury to vessels by the fine needle used is never dangerous, though it may result in hematomas which sometimes take a rather long time to be absorbed. The bleeding should be checked by means of firm local pressure.

After-effects.—*Edema* and swelling of the tissue are almost immediate; they increase until the second day, and disappear within a week.

Anesthesia of the skin or mucous membrane in the distribution of the injected nerve is *absolutely the rule*. It is associated with a "board-like" or "swollen" sensation. This anesthesia generally persists for four to six months.

Therapeutic Results.—The results obtained with this procedure are excellent in all instances of idiopathic facial neuralgia. Symptomatic relief following thoroughly successful injections remains complete for a year, eighteen months or even several years.

II.—LUMBAR PUNCTURE.

"The operative technic of lumbar puncture is as simple as that of puncture for ascites or of thoracentesis. No physician should hesitate to carry it out when it is indicated.

"Lumbar puncture permits of collecting the cerebrospinal fluid, disturbances or changes in which confirm the diagnosis or render it more precise. It likewise permits of injecting into the subarachnoid space or introducing into the cerebrospinal meningeal sac various therapeutic agents or anesthetics. The indications for lumbar puncture, then, meet three major requirements, *viz., anesthesia, diagnosis,* and *treatment.*" (Tuffier and Desfosses.)

Anatomic Landmarks.—A transverse line connecting the uppermost points of the two iliac crests crosses the spinal column at the spinous process of the fourth lumbar vertebra. This relationship permits of easy and practically infallible localization of the proper area for puncture. The spinous process referred to, when correctly located, is followed downward by the forefinger to its lower extremity; immediately

below and on either side is the fourth lumbar intervertebral space, the site of election for the purpose.

A needle entering at this point, either horizontally just below the spinous process mentioned, or preferably, slightly (½ centimeter) outside of the midline, will encounter in succession from without inward the skin, subcutaneous cellular tissue, lumbar fascia, muscles of the sacrolumbar group, the intervertebral ligamenta flava, the meninges, the dura mater and the arachnoid.

This layer of tissue varies greatly in thickness, according to the

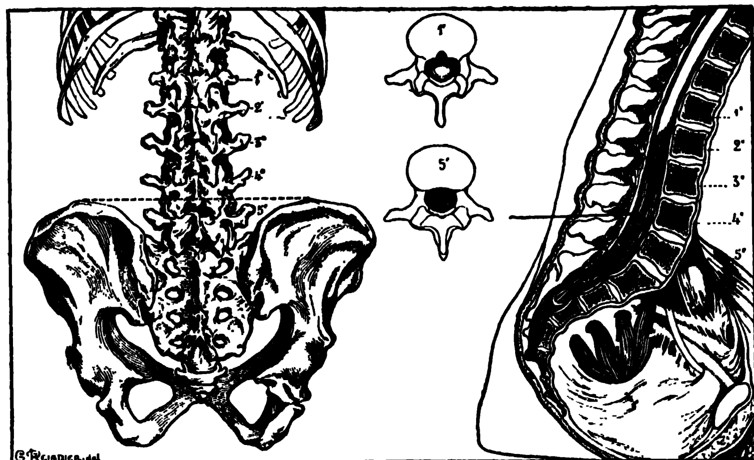


Fig. 217.—Diagram of the lumbar region (*Tuffier* and *Desfosses*).

On the illustration at the left are seen the bony landmarks: A horizontal line connecting the iliac crests crosses the spinal column at the spinous process of the 4th lumbar vertebra.—The illustration at the right shows that the terminal conus medullaris stops at the 2d lumbar vertebra; the black line indicates the site of election for puncture.

age of the subject and to whether his musculature is heavy or light and whether he is stout or thin. Thus, a needle 4 or 5 centimeters long may suffice in children; in a stout adult or one with a heavy musculature a needle 8 centimeters long sometimes has to be inserted up to its flange before it reaches the meningeal *cul-de-sac*.

Instruments.—If need be, any injecting needle, provided it is long, strong, and malleable, may be employed. It is better, however, if possible, to use a special needle similar to that of Tuffier, which is a needle of iridioplatinum, 8 centimeters long, with an external diameter

of 1 millimeter, an internal diameter of 0.6 millimeter, and with a short bevel, yet very sharp.

Position of the Subject.—The posture of choice is, if the patient's condition permits, the sitting position, with the thighs slightly apart, the arms resting on the thighs, and the subject bent forward, arching his back in order to secure a maximum of interval between the vertebral laminæ.

If there is difficulty or inability to assume this posture, as is some-



Fig. 218.—The surgeon's left forefinger locates the spinous process of the 4th lumbar vertebra; the right hand, holding the needle like a pen, prepares to execute the puncture (*Tuffier* and *Desfosses*).

times the case with patients suffering from cerebrospinal meningitis or in a grave condition, lateral decubitus should be employed, with the thighs strongly flexed on the pelvis and the legs on the thighs.

Technic.—The area in which the puncture is to be carried out having been disinfected with tincture of iodine, and the needle sterilized by boiling, the intervertebral space is identified for the last time and the needle introduced directly along the radial border of the forefinger, the latter marking the spinous process; it is inserted progressively and steadily, in a horizontal and slightly inward direction. At a depth which varies according to the muscular development of the

subject, a slight increase of resistance is noticed, due to the ligamenta flava; a slight increase of pressure overcomes the resistance and the needle penetrates almost at once into the spinal canal, as shown by the almost immediate appearance of fluid at the external end of the needle.

When the puncture has been completed, the needle is withdrawn with a quick movement and the site of the puncture closed with a little collodion.

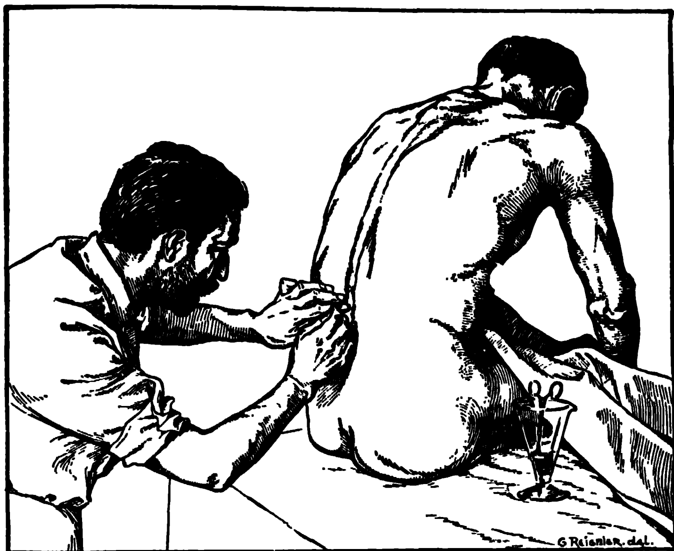


Fig. 219.—The needle has passed through the skin; the surgeon's right hand, resting against the lumbar region, pushes in the needle progressively.

Possible Mishaps.—Except in pusillanimous patients, local anesthesia is superfluous; in the former class of cases, the ethyl chloride spray may be used.

Some "nervous" subjects, at the moment of introduction of the needle, execute a practically uncontrollable straightening-up movement which would twist the needle asunder if deeply embedded in the tissues. This mishap is guarded against: (1) By using, as already mentioned, a strong, malleable needle. (2) By carrying out the puncture in three stages: (*a*) The skin and cellular tissue (the straightening movement takes place at this time); (*b*) the fascia and muscles down to the ligamentum flavum, the latter recognized by

the increase of resistance, and (*c*) the ligamentum flavum and the tissues beyond.

In very exceptional instances, anatomical anomalies, such as exostoses on the laminæ and ossification of the ligamenta flava, which may render puncture difficult or impossible, have to be reckoned with. In such a case the next lower interspace should be selected.

The majority of "dry" punctures are due to occlusion of the needle by a clot, flake of fibrin, or tissue débris. Passage of a stylet through the needle and slight displacement of the latter generally overcome this difficulty.

If the puncture yields pure blood, the needle has in all likelihood cut into a small vein within the dura mater; under these conditions the needle should be pushed in a little deeper; if the fluid is still

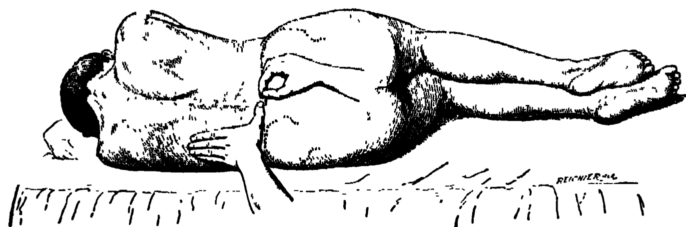


Fig. 220.—Lumbar puncture in lateral decubitus. The landmarks are the same as in the sitting posture.

frankly bloody, it should be withdrawn. It should be borne in mind, however, that in hemorrhages into the ventricles of the brain the cerebrospinal fluid may be very markedly discolored with blood.

Untoward Results.—Mainly in the earlier experiences with lumbar puncture, some fatal cases were reported, though these, it seems, were exclusively in patients with brain tumor or where excessive amounts of fluid had been withdrawn. Rather exceptionally, moreover, temporary headache, dizziness, backache, vomiting, convulsions, cramps, numbness, and tingling sensations have been reported.

Precautions.—The precautions recommended by Sicard, Minet and Lavoix may here be recalled:

1. Lumbar puncture should be refused in cases of suspected tumor or in which the symptoms (headache, nausea, dizziness) are accentuated by the recumbent posture.
2. Puncture should preferably be carried out in lateral decubitus.
3. After the puncture the subject should remain in bed in dorsal decubitus, with the head unsupported by any pillow.

4. *Except in the presence of special indications,* not more than 5 to 10 cubic centimeters of fluid should be withdrawn.

These precautions should be particularly insisted upon in tumor cases.

SIMPLE LUMBAR PUNCTURE.

Indications:

1. Where intraspinal **hypertension** appears as the main feature:
   (*a*) INSOLATION: Torpor, coma, delirium and convulsions greatly improved by removal of 15 or 20 c.c. on alternate days.
   (*b*) TRAUMA OF THE SKULL AND SPINE: Headache, coma, delirium and paralysis obviously improved by repeated daily withdrawal of 20 or 25 c.c.
   (*c*) BRAIN TUMORS: These constitute rather a *contraindication,* lumbar puncture having shown itself particularly dangerous in these cases. The majority of cases of immediate death after lumbar puncture have been in patients with brain tumor.

2. **Toxic States:**
   (*a*) *Puerperal eclampsia.*
   (*b*) *Uremia* of the nervous type. Lumbar puncture, sometimes repeated, reduces headache, delirium, convulsions, hallucinations, Cheyne-Stokes breathing and eye disturbances.
3. **Infection:**
   It proves effective mainly in the *headache* occurring during or after infections, often an obstinate symptom, especially in typhoid and post-typhoid headache.
   It allays the headache of secondary syphilis.

DRUG INJECTIONS.

1. **Anesthesia** (spinal analgesia).
2. **Antimeningococcic serum therapy** (see *Serum Therapy* and *Cerebrospinal Meningitis*).
3. **Miscellaneous Remedial Injections:**
   (*a*) ANTITETANIC SERUM.—The results remain doubtful.
   (*b*) COLLOIDAL METALS.—Collargol; results questionable.
   (*c*) ARSPHENAMIN and NEOARSPHENAMIN.
   (*d*) MERCURIAL SOLUTIONS (cyanides and biniodide).

X

MISCELLANEOUS THERAPEUTIC PROCEDURES.

I.—PARACENTESIS ABDOMINIS.

Paracentesis of the abdomen consists in puncturing the abdominal cavity for the evacuation of accumulated fluid, whether such fluid be free in the peritoneal cavity (ascites) or embodied in an intra-abdominal cyst.

Indications.—Paracentesis of the abdomen is being resorted to less often than formerly. Few conditions other than the ascites of hepatic cirrhosis and that of heart disease indicate its use.

Instruments.—For tapping an ascites, an ordinary trocar, all-metal and of medium size, should be procured and sterilized. The No. 3 trocar of the Potain aspirator, with the attached rubber tube—both to be sterilized—is still better. Before using it the physician should make certain that it is in good working condition and perfect order.

There should also be at hand: Two graduated glass receptacles each capable of holding 10 or 12 liters of fluid.

Tincture of iodine

Alcohol.

Sterile gauze pads, a package of ordinary cotton, a package of sterile absorbent cotton, a binder and a dozen safety pins.

Preliminary Preparations.—The operator should prepare his hands and the skin of the abdomen at the point selected for puncture with the same care as for a surgical operation. The patient should be extended in semi-recumbency on the side to be tapped (as the fluid collects at the most dependent point). The patient's head should not be left too high, on account of the possibility of syncope.

Technic.—If necessary, an ascites may be tapped at any point of the abdomen. The recognized site of election, however, is at the middle of a line connecting the umbilicus with the anterior superior spine of the ilium, preferably on the left when the liver appears to be diseased and on the right when the spleen seems affected; large varicose ramifications of the subcutaneous veins should be avoided. Puncture at

the site of election may be attended with risk on account of its vascular relationships; one may instead puncture three finger-breadths above the pubis in the midline after catheterization of the bladder.

The operator stands on the side of the intended puncture, exactly facing the prominence of the abdomen. He should carefully percuss for the last time at the point where the trocar is to enter. His left hand steadies the area to be punctured, while his right hand, pronated, holds the instrument, with its butt end in the middle of the palm. The right forefinger, directed forward, but half-flexed against the cannula, sets a limit to the distance the point of the trocar can penetrate into the tissues.

The introduction of the trocar should be clean-cut, firmly executed and decisive, and the instrument should pass in at right angles to the skin surface. As soon as the point has passed through the soft tissues, the right hand comes to a stop; the left hand takes hold of the cannula by its free end while the right quickly withdraws the trocar. The liquid in the abdomen spurts out. By way of precaution, the cannula is inserted at once, gently and for two-thirds of its length. The hand, which supports it lightly, should not be moved for as long a time as the ascitic fluid is coming out.

The fluid should be removed slowly; if the flow stops, the direction or depth of penetration of the needle or the position of the abdomen should be cautiously modified until the fluid reappears.

After completion of the tapping, the cannula is withdrawn quickly, with a single motion, in a direction perpendicular to the surface of the abdomen; this should be assisted by holding the skin in place with the left hand. The wound margins should then be at once pinched together, dried with pledgets of sterile absorbent cotton, and the continuity of the cutaneous, subcutaneous, muscular and peritoneal layers interrupted as much as possible to obviate the formation of a fistula.

Mishaps and Untoward Results.—Syncope.—Syncope is an exceptional development, but may be met with, either at the moment of puncture (emotion or pain), when ether and rubbing of the face and epigastrium will bring relief, or at the end of the evacuation, if much fluid (10 or 12 liters) has been removed. Collapse is an alarming and sometimes fatal accompaniment; a large ascites should never be tapped too rapidly.

Dry Puncture.—The fluid fails to appear, either because of edema of the abdominal wall, the point of the trocar not having passed through the parietal peritoneum (in which case the instrument should be inserted more deeply), or because of penetration of the trocar into

a patch of chronic peritonitis (tuberculous, cancerous or other) or a mass of thick pseudo-membranes.

Wrongly Located Puncture.—Because of the misshapen condition of the abdomen the landmarks may have been miscalculated and the trocar come to a stop against a rib, against the crest of the ilium, or in the liver, spleen or bowel; in the last-named event an immediate surgical operation can alone save the patient.

At present, with the fine trocars used, adequate aseptic precautions and the placing of the patient in dorsal decubitus, the cases of syncope *a vacuo* and of acute peritoneal infection reported by earlier writers need no longer be taken into account. There is, however, and always will be, a possibility of various untoward results coming on either at once or after the lapse of a varying period of time. These untoward



Fig. 221.—Ascitic abdomen in alcoholic hypertrophic cirrhosis. Line of dulness with concavity directed upwards (*P. Lereboullet*).

results may be divided into three main groups: Serous anemia; grave or aggravated icterus; hemorrhage into the abdominal wall; hemorrhage into the digestive tract, and cardiac dilatation *a vacuo.*

Serous Anemia.—After the tapping of cases of ascites there have been observed blood changes consisting in a momentary increase in the number of cells, due to a condition of blood concentration the result of the withdrawal of fluid which transudes from the vessels into the peritoneal cavity just emptied by the puncture. The blood being thus deprived of part of its serous components (watery portion and protein materials of the serum), the condition may well be called a serous anemia.

The serous anemia resulting after every tapping from the withdrawal of fluid is generally of short duration only (three to six days); but sometimes repeated paracenteses at short intervals induce a special clinical condition which may be termed chronic serous anemia.

The face is thin, the nose peaked, the features drawn, the complexion of a leaden hue, and the skin dry. Each successive tapping increases the general depression; the strength wanes, and the progressive depreciation of the organism leads ultimately to a fatal issue.

Grave Icterus and Aggravated Icterus.—Increased intensity of jaundice sometimes follows abdominal tapping.

Hemorrhage into the Abdominal Wall.—In such a case much blood escapes through the cannula along with the ascitic fluid. Whether the condition results from the wounding of a varicose subcutaneous vein or an arterial branch ensconced in the abdominal wall, operative search for, followed by ligation of, the vessel is necessary. These hemorrhages of parietal origin must, of course, be differenti-

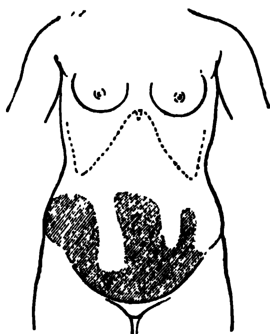


Fig. 222.—Ascitic dulness in loculated tuberculous peritonitis.

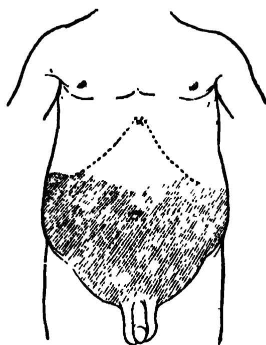


Fig. 223.—Ascitic dulness in Laënnec's cirrhosis.

ated from the "hemorrhagic ascites" due to a peritonitis with pseudomembrane formation; in the latter case the brownish fluid does not, as in the preceding form, lead to a discharge of rapidly coagulable blood.

In another contingency, the hemorrhage in the parietes takes place very slowly, infiltrating the wall and yielding at the orifice only an oozing of blood-stained serous fluid.

Hemorrhage into the Alimentary Canal.—Hemorrhage into the alimentary canal following evacuation of an ascites may either be rapidly fatal or be compatible with survival for a more or less prolonged period.

To obviate accidents of this type, not only should suitable diet and therapeutic measures be instituted as soon as possible, but the abdomen should be emptied only slowly through a fine trocar—which

is advantageous in many ways—and a tight binder applied immediately after the puncture, in order to reduce the effects of decompression.

Cardiac Dilatation "a Vacuo."—The sudden decompression produced by the removal of the ascitic fluid results in a lowering of the diaphragm which had been displaced upwards before the puncture. This lowering is accompanied by increased capacity of the thorax, and in patients with deficient cardiac tone there is produced a dilatation of the heart *a vacuo,* with stagnation of blood in the lesser circulation and a condition of collapse. Here, again, a tight binder placed around the abdomen immediately after puncture will exert a useful effect in resisting this unduly rapid descent of the diaphragm.

Fistula Formation.—Oozing of ascitic serous fluid through the channel left by the trocar may continue for several days. It tends to discolor the skin locally and becomes an actual source of danger by threatening the peritoneal layer with infection. In such cases aseptic dressings should be renewed several times daily with the most scrupulous care until the fistulous tract has definitely closed.

Acute Peritoneal Infection.—Whether this be due to a septic paracentesis; to septic inflammation of the skin wound (contaminated secondarily), or, as happens very rarely, to emptying into the peritoneal cavity of a septic focus opened by the trocar, the acute peritonitis following abdominal puncture is in most cases fatal. It demands emergency surgical treatment.

After-care.—After the paracentesis a dry dressing of gauze and aseptic cotton should be applied. The entire abdominal wall should be covered with a thick layer of cotton held in place by a pliant but tight abdominal bandage. The patient should remain completely at rest in bed in dorsal decubitus; he should be forbidden to get up or subject himself to the least exertion during the forty-eight hours following the operation.

II.—MASSAGE OF THE ABDOMEN.

Abdominal massage is intended:

1. To improve the abdominal and even the general circulation; the measure exerts a marked influence on the nerve plexus and circulation of the portal vein.

2. To tone up the muscles of the abdominal wall and increase the power of intestinal peristalsis.

3. To activate secretion by the glands of the abdomen (liver and pancreas chiefly), to facilitate absorption from the intestine, and consecutively, to increase the output of urine.

4. To allay certain painful states of the stomach and abdomen.

Indications and Contraindications.—Massage of the abdomen is especially *indicated* in cases of gastric atony, beginning dilatation of the stomach, gastro-enteroptosis, constipation, and gastric disorders in which powerful suggestive measures are required, *i.e.*, in all disturbances of a sensory nature, including nervous dyspepsia. It should also be used in heart disorders as soon as the evidences of decompensation appear, such as edema of the lower extremities, dyspnea on exertion and hepatic congestion. In this connection, the following opinion, expressed by Cautru, may be regarded as authoritative: "Pétrissage [kneading] of the abdomen relieves the portal system just as pétrissage of the extremities relieves the peripheral venous system; it is probable, moreover, that it acts on the sympathetic, whence a vasomotor influence on the arterial contractions is exerted; the action on the renal plexus entails phenomena of contraction and dilatation of the vessels of the kidney, whence there result diuresis and disappearance of edema." Hirschberg has thus been able to increase the daily output of urine from 1500 cubic centimeters to 2200, 2400 and 3000 cubic centimeters. A dropsical patient was enabled to pass 3 to 4 liters of urine as a result of moderate daily massage (Gumprecht).

The *contraindications* comprise all the hemorrhagic or inflammatory disorders of abdominal organs. This applies to ulcer, to tumor of the stomach, to acute or chronic appendicitis, and to pelvic infections in women (salpingitis, perimetritis and cystitis).

One cannot be too careful in securing a firm foundation for clinical action in this connection; but once the necessary assurances have been secured (as by watching the temperature for several days and careful examination of the patient), very gratifying results from abdominal massage will be obtained.

Articles Required.—Talcum powder.

Preliminary Preparations.—One should see to it that the patient has emptied his bladder before massage is begun. The patient's abdomen should be absolutely clean, as should also the hands of the operator, which should be dry, warm and well covered with talcum powder.

Technic.—The patient is in semi-recumbency, with the knees flexed and slightly separated. Under these circumstances the abdominal muscles are in a state of complete relaxation. The massage is prac-

tised directly on the bare skin. Three forms of massage are to be distinguished:

Soothing superficial massage, consisting of gentle, repeated rubbings of the skin.

Stimulating superficial massage, consisting of percussion massage, hachement, and superficial vibratory massage.

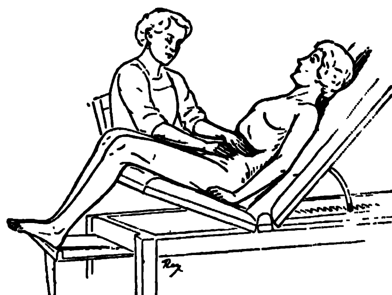


Fig. 224.—Effleurage of the abdominal wall.

Deep massage, consisting of deep rubbing, slow pressures, kneading, and malaxation (with one or both palms).

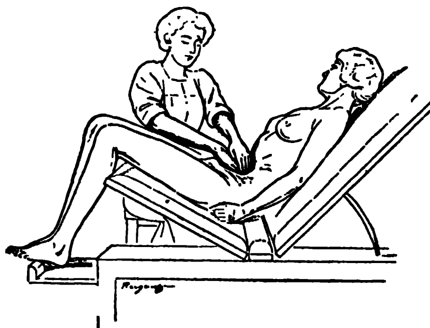


Fig. 225.—Rubbing over the descending colon.

Massage of the Stomach.—This is carried out three to six hours after meals or in the morning before breakfast. The patient is semi-recumbent, in the same position as for massage of the abdomen. The sitting is begun, as always, with effleurage (stroking), which has for its purpose to soothe the patient and prepare him to withstand the later manipulations.

After four or five minutes of effleurage, massage of the stomach is begun with deep pétrissage, the masseur's two hands being brought together from the sides of the abdomen until they meet, meanwhile kneading deeply into the abdomen. In carrying out the vibratory massage, the physician stands at the side of the patient and places

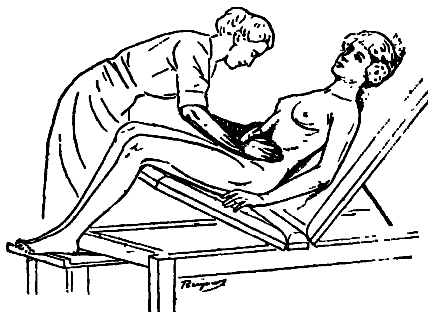


Fig. 226.—Malaxation of the whole intestinal mass.

his two hands together over the greater curvature of the stomach. Vibratory movements in the vertical direction are then executed.

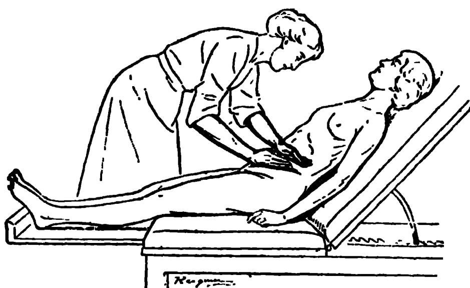


Fig. 227.—Effleurage of the descending colon.

On the empty stomach, the maneuver is gone through with the operator at the head of the patient and executing gentle and deep circular rubbing movements with the fingers flexed at a right angle.

General Massage of the Abdomen.—The physician is seated on the patient's right side with his face turned towards him. The séance is begun with effleurage of the abdominal wall, carried out in circular fashion, clockwise, with both hands at the same time. While one

hand is beginning the effleurage, the other is completing it The right hand begins the procedure at the left iliac fossa (Fig. 224).

The large intestine is next dealt with. For this purpose, the physician places both hands on the left side of the abdomen, over the sigmoid flexure. With one hand on top of the other and the fingers kept in hyperextension as for deep palpation, he executes rubbing movements with the palmar surfaces of the first two phalanges of the three middle fingers. The physician then follows the descending colon up to the splenic flexure and continues at once along the transverse colon, following its course. When the ascending colon is reached, the operator turns his hands so that the fingers are directed outward toward the right iliac bone. Care should be taken to practice massage thoroughly over the flexures of the colon, which are favorite sites for fecal stagnation. This rubbing of the colon is repeated three or four times (Fig. 225).

The small intestine is then treated; the rubbings should again be carried out with the tips of the fingers.

Massage of the Small Intestine.—The physician places his hands one on top of the other over the umbilicus, with the palmar surfaces kept slightly concave, the better to hold the intestinal mass. He then executes circular movements with his hands without displacing them from their position; he first makes pressure with the proximal part of the hand, then in succession with the radial border, the ends of the fingers, and the ulnar border, and next again with the proximal portion. At no time during this movement should the hand lose contact with the abdominal wall.

To malaxate the intestinal mass all at one time, the physician, standing in front of the recumbent patient, places his hands slightly above the ilium and from this point descends toward the pubis, carrying out extensive rubbing movements with the two hands alternately (Fig. 226). These rubbing movements should be repeated three or four times. When they are finished, the operator again places his hands above the ilium, draws the entire mass of intestines towards him and compresses it, so to speak, between his hands, which are alternately executing a to-and-fro movement.

The treatment is concluded with effleurage of the colon. The patient should lie down flat for this purpose, with his knees extended. The left hand of the physician, starting from the right iliac fossa, travels up along the ascending colon; the effleurage is carried out chiefly with the proximal portion and external border of the hand. Having reached the hepatic flexure, the hand is turned so that the fingers are directed to the left, and the effleurage continued over the

transverse colon. Over the descending colon, the two hands are used in succession, one hand continuing the effleurage over the transverse colon while the other executes the same maneuver over the descending colon; the movements of the two hands thus follow and complete each other (Fig. 227).

The sitting may be concluded also with percussion-massage and hachement (chopping movement) with the edge of the hand over the entire abdominal surface.

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